The International Military Digest

Annual

1918

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A Review of The Current Literature of Military Science

for 1918

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Table of Periodical Title Abbreviations

Recent issues of the following periodicals have been digested, in whole or in part, for this volume of the INTERNATIONAL MILITARY DIGEST. *Practically the entire contents of the distinctively military periodicals are digested. From the popular or general periodicals (designated in this list by an asterisk [*]) only articles on military topics or of military significance are digested.*

ABBREVIATED REFERENCE TITLE	FULL TITLE AND ADDRESS
*Aerial Age**	Aerial Age. Weekly. 280 Madison ave., New York City.
*Aeronautics**	Aeronautics. Monthly. 250 W. 54th street, New York City.
Air Service Jour.	Air Service Journal. 120 W. 32d st., New York City.
Arms & Explosives	Arms and Explosives. Monthly. Arundel st., Strand, London, W. C.
Arms and the Man	Arms and the Man. Weekly. 1502 H street, N. W., Washington, D. C., N. S. A.
Army & Navy Gazette	Army and Navy Gazette. Weekly. 22 Essex street, Strand, W. C., London.
Army & Navy Jour.	Army and Navy Journal. Weekly. 20 Vesey street, New York City.
Army and Navy News	Army and Navy News. Monthly. San Francisco, California.
Army & Navy Register	Army and Navy Register. Weekly. 511 Eleventh st., Washington, D. C.
Artilleri Tidskrift	Artilleri Tidskrift. Bi-monthly. Almquist and Wiksello Boytryckeri A. B., Upsala, Sweden.
*Atlantic Monthly**	Atlantic Monthly. Monthly. Atlantic Monthly Co., Boston.
Australian Mil. Jour.	Australian Military Journal. Quarterly. Victoria Barracks, Melbourne, Australia.
*Aviation**	Aviation and Aeronautical Engineering. Semi-monthly. 120 W. 32d street, New York City.
Boletín de Guerra	Boletín del Ministerio de Guerra y Marina de Perú. Fortnightly. Apartado de Correo No. 91, Lima, Peru.
Canadian Military Gazette	Canadian Military Gazette. Semi-monthly. Room 16, Trust Bldg., Ottawa, Canada.
*Century**	Century Magazine. Monthly. 353 Fourth ave., New York City.
*Commercial Vehicle, The**	The Commercial Vehicle. Bi-monthly. 239 W. 39th st., New York City.
*Contemporary Review**	Contemporary Review. Monthly. London. 7 Warren st., New York, Leonard Scott.
Dansk Artilleri Tidsskrift	Dansk Artilleri Tidsskrift. Monthly. Herluf Trollesgade, 23, Copenhagen, Denmark.
Dansk Militaert Tidsskrift	Dansk Militaert Tidsskrift. Bi-weekly. Rosenvaegets Alle 14, Copenhagen, O.
Field Artillery Jour.	The Field Artillery Journal. Quarterly. U. S. Field Artillery Association, 1701 Pennsylvania ave., Washington, D. C.
*Flying**	Flying. The Flying Association, Inc. 280 Madison ave., New York City.
*Fortnightly Review**	Fortnightly Review. Monthly. London, 7 Warren st., New York. Leonard Scott.
Guerra y Su Preparación	La Guerra y Su Preparación. Monthly. Madrid. Tallero del Depósito de la Guerra.
*Independent**	The Independent. Weekly. 130 Fulton st., New York City.
Infantry Jour.	Infantry Journal. Bi-monthly. U. S. Infantry Association, 814 Seventeenth st., Washington, D. C.
*Jour. Aeronautical Soc.**	Journal of the Aeronautical Society of America. Monthly. New York, N. Y.
*Jour. Amer. Medical Assn.**	Journal of the American Medical Association. Weekly. American Medical Association, 535 North Dearborn st., Chicago, Ill.
*Jour. Franklin Inst.**	Journal of the Franklin Institute. Monthly. Philadelphia, Pa.

*Jour. Political Econ.**	The Journal of Political Economy. Monthly. University of Chicago Press, Chicago, Ill.
Jour. Royal Artillery	The Journal of the Royal Artillery. Monthly. Woolwich, England.
Journal R. U. S. Institution	Journal of the Royal United Service Institution. Quarterly. Royal United Service Institution, Whitehall, London, S. W.
Jour. U. S. Artill.	Journal of the United States Artillery. Bi-monthly. Fort Monroe, Va.
Jour. United Service Inst. India	Journal of the United Service Institution of India. Quarterly. Simla, India.
Jour. U. S. Cavalry Assn.	Journal of the United States Cavalry Association. Bi-monthly. Fort Leavenworth, Kans., U. S. A.
Kaikosha Kiji	Kaikosha Kiji. Monthly. Tokyo, Japan.
Krigsvetenskaps Akadamiens Tidskrift	Krigsvetenskaps-Akadamien Handlingar och Tidskrift, (Proceedings of the War Institute). Published irregularly after meetings. P. A. Norstedt & Söner, Stockholm, Sweden.
L'Aeronauta	L'Aeronauta. Monthly. Via della Dogana Vecchia, 27, Rome, Italy.
Marine Corps Gazette	The Marine Corps Gazette. Quarterly. 24 E. 23d st., New York City.
Marines Magazine	The Marines Magazine. Monthly. 1734 New York ave., N. W., Washington, D. C.
Memorial de Aritlleria	Memorial de Artillería. Monthly. Museo de Artilleria, Madrid.
Memorial de Caballería.	Memorial de Caballería. Madrid, Spain.
Memorial del Ejército de Chile	Memorial del Estado Mayor del Ejército de Chili. Monthly. Talleres del Estado Mayor General, Santiago, Chili.
Memorial del Estado Mayor de Colombia	Memorial del Estado Mayor del Ejército de Colombia. Bi-monthly. Estado Mayor General, Bogotá, Colombia.
Mem. de Infantería	Memorial de Infantería. Monthly. Ministry of War, Madrid, Spain.
Memorial de Ingenieros	Memorial de Ingenieros del Ejército. Monthly. Calle de los Martires de Alcalá, Madrid.
*Mil. Hist. and Econ.**	The Military Historian and Economist. Quarterly. Harvard University Press, Cambridge, Mass.
Military Surgeon	The Military Surgeon. Monthly. 7th and B streets, Washington, D. C.
Modern Hospital	The Modern Hospital. Monthly. The Modern Hospital Publishing Co., Metropolitan Building, St. Louis, Mo.
Norsk Artilleri Tidsskrift	Norsk Artilleri Tidsskrift. Monthly. Christiania.
Norsk Militaert Tidsskrift	Norsk Militaert Tidsskrift. Monthly. Christiania.
Nuova Rivista di Fanteria	Nuova Rivista di Fanteria. Monthly. Via Viminale, 58, Rome.
O Tiro de Guerra	O Tiro de Guerra. Monthly. Rio de Janeiro, Brazil.
Organ der Krijgswetenschap	Organ der Vereeniging ter Beoefening van der Krijgswetenschap. Monthly. C. Blommendaal, 's-Gravenhage, Holland.
*Outlook**	The Outlook. Weekly. 381 Fourth ave., New York City.
*Popular Science**	Popular Science Monthly. Monthly.
Proceedings Naval Institute	Proceedings of the Naval Institute. Bi-monthly. Annapolis, Md., U. S. A.
Professional Memoirs	Professional Memoirs of the Corps of Engineers. Bi-monthly Washington Barracks, D. C., U. S. A.
*Railway Age Gazette**	Railway Age Gazette. Weekly. Simmons-Boardman Publishing Co., Woolworth Building, New York City.
*Review of Reviews**	The Review of Reviews. Monthly. 30 Irving Place, New York City.

Rev. del. Circulo Militar	Revista del Circulo Militar. Monthly. Maipú 255, Buenos Aires, Argentina.
Revista Militar (Argentina)	Revista Militar. Monthly Ministerio de Guerra, Santa Fe, 1461, Buenos Aires, Argentina.
*Revue des Deux Mondes**	Revue des Deux Mondes. Semi-monthly. 15 Rue de l'Université, Paris
Rivista di Artiglieria e Genio	Rivista di Artiglieria e Genio. Monthly. Tipografia Enrico Voghera, Via Astalli 15, Rome.
Rivista di Cavalleria	Rivista di Cavalleria. Monthly. Scuola di Applicazione di Cavalleria Pinerola, Italy.
Riv. Mil. Italiana	Rivista Militare Italiana. Monthly. Rome, Italy.
Royal Engineers Jour.	The Royal Engineers' Journal. Monthly. Chatham, England.
Schweiz. Zeitschrift f. Art. u. Genie	Schweizerische Zeitschrift für Artillerie und Genie. Monthly. Verlag von Huber & Co. Frauenfeld, Switzerland.
*Scientific American**	Scientific American. Weekly. 361 Broadway, New York City
*Scribner's**	Scribner's Magazine. Monthly. 597 Fifth ave., New York City.
*Sphere**	The Sphere. Weekly. Great New st., London, E. C,
Svensk Intendentur Tidskrift	Svensk Intendentur Tidskrift. Monthly. Frederikshaf, Stockholm 14, Sweden.
Svensk Kustartilleritidskrift	Svensk Kustartilleritidskrift. Quarterly. A. B. Amiralitets & Stadsboktryckeriet, Karlskrona, Sweden.
Tidskrift i Fortifikation	Tidskrift i Fortifikation. Monthly. Kungl. Boktryckeriet, P. A. Norstedt & Söner, Stockholm, Sweden.
United Service Mag.	United Service Magazine. Monthly. 31 Haymarket, London, S. W.

International Military Digest Annual

1918

A REVIEW OF THE CURRENT LITERATURE OF MILITARY SCIENCE

Main entries are indicated by **BLACKFACE CAPS;** subheads by **lower case blackface;** geographical subdivisions by *italic* center heads.

NOTE.—*The digests of articles presented herein are merely condensed statements of the original articles. The Editors assume no responsibility for the opinions or conclusions, which are those of the individual authors. Any editorial comment is enclosed in brackets* [].

A. E. G. AIRPLANE

[The German A. E. G. Bombing Biplane. *Aerial Age Weekly*, Jan 7, '18. 1685 words. Illustrated.]

The A. E. G. firm was, perhaps, one of the first in Germany to turn its attention to machines of large dimensions, altho not to such extent as the Capronis in Italy or the Handley-Pages in Great Britain. One of the first A. E. G. twin-engine biplanes to become known to pilots on the Western front made its appearance during 1916. This machine had a long covered-in fuselage providing accommodation for the pilot and gunners, while the two engines were placed on the wings, sufficiently far out for the two tractor screws to clear the nose of the fuselage. The A. E. G. has its two airscrews placed in front of the main planes. As in the Gotha, the wings of the A. E. G. are swept back at a 5 degree angle and are also placed at a dihedral angle, which appears to be greater in the bottom than in the top plane. The span is the same for both planes and amounts to 57 ft., while the overall length is about 30 ft. 6 in.; chord, 7 ft.; area, 800 sq. ft.; gap, 8 ft. 6 in.-7 ft. 5 in. The ailerons, which are of a peculiar shape, are fitted to the top plane only, and are operated by a crank lever working in a slot in the plane. The tail planes, which are of the monoplane type, consist of fixed stabilizing planes with an area of 30 sq. ft.; and a vertical fin, to which are hinged the elevators and rudder respectively. A tail skid is fitted under the stern of the fuselage, and is sprung, not by means of rubber shock absorbers as is usually the case with our machines, but by means of coil springs. The same is the case with the landing chassis, where coil springs are also used instead of rubber.

The material used in the construction is, with very few exceptions, steel, practically the only parts made of wood being the ribs of the main planes. The main spars are in the form of steel tubes, which is rather surprising in view of the fact that about the worst use to put a circular section to is to employ it as a beam laterally loaded, since much of the material of such a section will be situated at or near the neutral axis, where it is adding weight without contributing greatly towards the strength. The strut socket, which resembles those usually found on German machines, is attached to it by welding. Like the rest of the machine, the fuselage of the A. E. G. bomber is built up of steel tubes, this material being used for longerons as well as for struts and cross members. In the front cock-pit —at the extreme nose of the body—is a seat for the bomber, who views the ground below and obtains his sights thru a circular opening in the floor. On his right he has a rack to hold bombs; these are presumably not of a very heavy calibre. Under the center of the body there is another bomb rack carrying the heavier projectiles. In the center cockpit there are two seats, side by side, occupied by two pilots, or presumably by two pilot-gunners, one relieving the other at the controls during a long flight. Behind the pilot's cockpit is that of the gunner, who operates a machine-gun mounted on a turn-table, which allows of firing the gun laterally as well as upwards and to the rear. On the left-hand side of the gunner's cockpit there is another bomb-rack carrying a similar store of bombs to that in the pilots' cockpit. In the floor of the bay to the rear of the gunner's cockpit there is a trap-door, hinged along its rear edge. A small pivot mounted on the floor forms the support for the gun when firing thru the trap-door.

The engines—which are generally of the 260 h.p. Mercédès type—are placed one on each side on the center section of the lower plane. The main fuel tank is not carried in the engine housings, but in the pilot's cockpit, where it forms, as a matter of fact, the support for the two seats. The mounting of the engines on the lower plane center section is somewhat unusual, and may be best understood by a study of the drawings. The undercarriage has been so designed that the outer wheels on each side is located directly underneath the corresponding engine, while the inner wheel is supported on another Vee from the lower plane. The object is plainly to let the inner wheels take part of the load of the central fuselage, but the manner of carrying out the idea does not strike one as particularly ingenious. Altogether the strutting of engines and undercarriages appears clumsy and complicated, and must, it would appear, present a great amount of head resistance. The two axles are slung from the apex of the Vees by coil springs, and not by rubber bands or cords. The speed is not known, but a rough estimate would appear to indicate as a reasonable figure about 90 m. p. h.

ACADEMIES, Military

See

SCHOOLS, MILITARY

ADMINISTRATION, Military

See also

AERONAUTICS—ORGANIZATION AND ADMINISTRATION

SUBSISTENCE—ORGANIZATION AND ADMINISTRATION OF

AERIAL ARTILLERY

See also

ANTI-AIRCRAFT ARTILLERY

FIELD ARTILLERY—FIRE—AGAINST AIRCRAFT

AERIAL WARFARE

See

AERONAUTICS

AERONAUTICS

See also

A. E. G. AIRPLANE

AGO BIPLANE

ANTI-AIRCRAFT ARTILLERY

BOMBS—AERIAL

DIRIGIBLES

FIELD ARTILLERY—FIRE CONTROL—AERONAUTIC

FOKKER AIRPLANE

HANGARS

HANSA-BRANDENBURG AIRPLANE

HYDROAIRPLANES

KITE BALLOONS

METEOROLOGY

PEUGEOT MOTOR

[Aviation and Aerostation. By Capt. Zuloaga. *Revista Militar* (Argentina), Oct, '17. 2100 words.]

The writer, who is a member of the Argentine Military Mission in France, proposes to discuss the above subject under the following themes:

1. The essential missions of aviation and the type and apparatus for each.
2. Elements that correspond to each apparatus to enable it to fulfill its mission. (Arms, bombs, photographic machines, etc.)
3. Organization of schools, groups and squadrons.
4. The service of advance and rear guards.
5. Personnel.
6. Aerostatic parks, dirigibles and captive balloons.

The first theme is started in this number. The missions of aviation are given as:

(a) Battle with hostile aircraft.
(b) Reconnaissance at a distance.
(c) Work on the battlefield.
(d) Bombing.

[Artillery and Aviation. Capt. Carlos M. de Campos. *Memorial de Artillería*, Mar, '18. 19,000 words.]

PART 3: FIRE CORRECTION

The Development of Airplanes in the English, French and German Armies

In Feb. 1914, the British reconnaissance airplanes had to be able to travel 300 miles at a speed between 50 and 85 miles per hour. The conditions for heavy two seaters equipped with wireless were a range of activity of 200 miles, and a speed of from 35 to 60 miles per hour; for the bombarding planes 300 mile range and a speed between 45 and 75 miles per hour. Besides these conditions, the usual conditions as to climbing power and visibility were required.

England was dependent upon France for airplane motors and on Germany for magnetos.

At the beginning of the war, the English biplanes were mostly of the Maurice, Henri Farman, and Caudron types, while the monoplanes were Nieuport, Deperdussin and Blériot makes, equipped with Gnome 50 to 80 h.p. motors and Renault 70 h.p. motors.

Fifty airplanes accompanied the first British Expeditionary Force of 100,000 men to France. This was considered a good proportion at that time.

France was by far the leading nation in aero activities of all sorts before the war. The French Army was equipped with 500 serviceable planes in August, 1914. This fact was common knowledge, no attempt having been made to keep it a secret.

In the German army conditions were not so good, as to quality. The German types were heavy and loggy, preference being given to security over speed. In quantity, however, the Germans were superior to France, as they were equipped with 600 planes of various types for active warfare and 100 planes for training purposes. Twenty stations were established by the Germans along the frontiers which were provided with the necessary apparatus to facilitate night flying. For several months before war was declared German and Austrian officers were planted in the most important allied aerodromes for observation purposes.

To begin with, two uses of the airplane were known: the strategic reconnaissance, and the throwing of bombs. Fighting planes did not appear until late in August, and aerial fire correction for artillery was not tried until later.

The 500 French, 80 English, and 30 Belgian planes were all used for strategic reconnaissance from the very first, but they were not sufficient to cover the entire front of 400 kms.

Due to the long range of action of the airplanes, it soon became customary to use them in making voyages into the interior of countries on bombing expeditions. It was preferred to drop 50 kgs. of bombs 200 kms. from a base than to drop 300 kgs. 50 km. from the same base, but on the enemy's reserves.

The most interesting of these raids were those accomplished by the Germans against the British towns. Up to Oct 1, 1917, 86 of these raids had been carried out.

On Sept 23, 1914, English planes made a raid of 400 kms. from Ypres on the city of Düsseldorf, where Zeppelin sheds were bombed. During the same month French planes based at Dunkirk bombed Cologne and Düsseldorf.

On Oct 25, 1914, three English officers left Belfort and bombed the airplane works at Friedrichshafen on Lake Constance with success, completely destroying one Zeppelin and doing severe damage to the factory

where many large machines were being constructed. The distance between Belfort and the objective was 200 kms. Two aviators returned safely.

Lastly, on Dec 23, 1914, seven English hydroplanes, starting from the British ships *Arethusa* and *Undaunted* near Heligoland, flew over Cuxhaven and dropped bombs on several large German warships. Only three machines returned, but this raid was considered a great success as the Germans brought every sort of anti-aerial gun into action against the Britishers.

The majority of German raids during the first year of the war were made in Taube planes, which are now out of date. These machines were invented by an Austrian millionaire, Ettrich, who was a believer in the monoplane and who claimed an excellent stability could be gained by constructing the planes in the shape of the leaves of the Indian "zanonia" tree which are often carried several kms. by the wind without once turning over. The Taube was used for the first raids and long distance reconnaissances, and was at one time the master machine in the air.

Modern Airplanes

It soon became evident to all the belligerents that the various airplane services would have to be specialized, and special machines built for the different tasks to be accomplished. The development of aircraft went forward by leaps and bounds after August, 1914, the conglomeration of types reaching a maximum at the end of 1916.

The characteristics of machines and types most used at that time were as follows:

Types	Seats	Power	Military Load	Radius of Action
		h.p.	kg.	km.
Planes of elementary schools which can be used for correction of artillery fire....	2	80	170	315
Planes of higher schools which can be used for tactical reconnaissance over woods and mountains	2	100	180	480
Chasing or hunting planes....	1	110	90	505
Twin-motored planes for general utility	2	260	250 to 500	720 to 960
Airplanes for reconnaissance against an enemy not provided with airplanes..........	2	130	215	665
Bombing planes	2	130	225	575

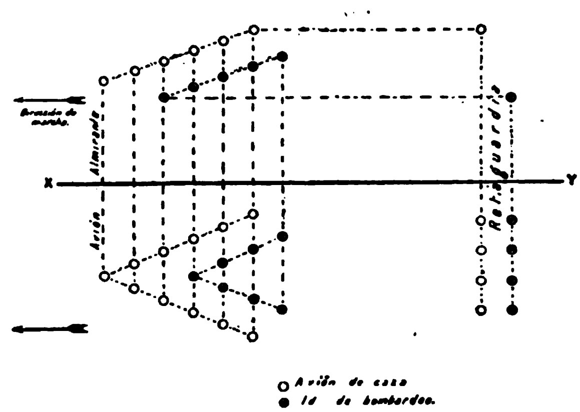
The development of airplanes was along lines which tended to increase the carrying capacity of the small, swift machines, and to increase the speed of the heavy machines.

At present the Albatros factory constructs two types of planes—one biplane for general service, and the hunting type biplane. This illustrates the manner in which the number of types has been cut down. It has been found that a biplane of the general service type is perfectly suitable for artillery fire regulation.

The general rules of warfare on land are applicable to air fighting, consequently for this work the aerial fighting squadron will have to be composed of scouting planes, security planes, and fighting or battle planes.

The first two will have to be extremely fast in order to escape any attack once the reconnaissance has been made, and will have to carry enough petrol to make the many trips their name implies. Security planes will establish advance, flank, and rear guards, and will also be of the scouting type. The main body in this form of combat is made up of battle planes, which once contact is established with the enemy will employ essentially offensive tactics.

Bombing planes are in an entirely different cate-



Dirección de marcha (Direction of march).
Avion Almirante (Squadron commander's plane).
Retaguardia (Rearguard).
Avion de caza (Pursuit plane).
Avion de bombardeo (Bombing plane).

gory. They have a special mission, and their power depends upon the weight of bombs they can carry.

Bombing raids have been the result of long distace reconnaissance trips into enemy territory and the type of plane best suited for bombing is what is known as the reconnaissance or bombing plane—the modern general utility airship.

The formations for bombing trips as well as for aerial combats are similar and are illutrated by the accompanying figure.

It has the advantage that the chaser machines which flank the combat planes both laterally and vertically always preserve the mastery of the air, the fields of fire are extensive in every direction, and lastly every machine is out of the air currents caused by other machines.

The following are some of the characteristics of the German planes:

The Albatros type, manufactured by the Albatroswerke Gesellschaft, presents the following points:

Length of planes	11.25 meters
Surface of principal planes	35 sq. meters
Diam. of propeller	2.75 meters
Total length	7.8 meters

The planes have no horizontal angle of incidence. The lower planes are slightly cutaway, but of the same width as the upper planes. Originally the Albatross planes were equipped with a 100 h.p. Benz & Argos motor, which gave them a speed of 110 kms.

AERONAUTICS—Continued

per hr. for four hours at a trip. This was later replaced by a 170 h.p. Mercédès motor.

The Aviatik, L. V. G., and D. F. W., factories build a plane which is the result of a combination of various heavy types, and is called the L. V. G. biplane. It has the following characteristics:

Length of planes, tip to tip	12.84 meters
Total length	8.10 meters
Lifting surface	38 sq. meters

The upper and lower planes are the same width and the wings have a large horizontal angle of incidence. The machine climbs at the rate of 2000 mm. in 20 seconds, and has a radius of action of 450 kms., which it covers in five hours. It is equipped with the 170 h.p. Mercédès motor.

The modern Aviatik has the following dimensions:

Width of planes, tip to tip	12.60 meters
Total length	8.15 meters
Width of wings	1.85 meters
Lifting surface	41 sq. meters

This machine weighs 805 kgs., and carries a useful load of 650 kgs. It is equipped with the 170 h.p. Mercédès motor. The most modern of these machines is the L. V. G.-D. F. W., which is equipped with a 227 h.p. Benz motor and has a lifting surface of 42 sq. meters. The Benz is a six-cylinder motor in vertical block.

The twin-motored Gotha is the latest type of general utility plane. It has two 260 h.p. Mercédès motors. It is a three-seater.

The aerial counter attack is based upon great climbing ability, in order that counter-attacking planes may get above the attackers rapidly. This fact gave rise to the Fokker type of pursuit plane. The Fokker plane is equipped with an 80 h.p. Oberursel motor.

The stability of airships has been an all important question during the development of this side of modern warfare. For a military plane, enough inherent stability is required so that (1) a machine which has been upset for any reason will always go into a nose dive; (2) the pilot should be able to release all controls and the machine should preserve its equilibrium and direction of flight for several seconds.

The pilot of a chaser plane should know exactly the conditions of stability of his own plane, and he will learn this instinctively. He should be able to perform the various "stunts."

Chasing planes are usually organized into squadrillas which may be used for any one of various purposes, for instance, in regulating artillery fire.

The regulation of artillery fire by airplanes is made necessary because the target in modern war is usually covered or sheltered so that it cannot be seen from the battery or from a point slightly elevated above the battery. Great altitude is not necessary for artillery fire correction from airplanes. Captive balloons may be used. A slow plane can make all the necessary observations. The climbing power of an artillery fire correction plane should not be less than 800 meters in ten minutes.

The visibility should be the maximum possible. In all airplanes this is an important factor, but it is especially important in those used for correction of artillery fire. In the Morane-Saulnier monoplane, the wings are above the pilot and he has practically an unobstructed view.

Various Airplane Weapons

At the beginning of the war steel arrows or darts were thrown from airplanes. The French killed the German General von Meyer with one of these darts, but the net results of their use were entirely unsatisfactory, so they were abandoned.

Machine guns are usually mounted in airplanes on a universal joint so that they can be fired in any direction. Originally they were mounted two in a heavy plane and one in a pursuit plane. Garros was the first man to fire with a fixed machine gun by aiming the plane at the target. In case the machine gun is mounted on the hood and fires thru the propeller, the fire is started by means of a Bouden transmission connecting the motor with the machine gun. An eccentric on the crank shaft and a set of gears regulate the fire so that bullets will not strike the propeller. The Fokker plane has an armored propellor so that bullets will not injure it. The Nieuport plane is arranged with machine gun on the top of the upper wing. In the single-seater machines the controls are arranged so that they can be handled with the knees while the operator changes ammunition belts and makes correction in the fire. In some machines such as the Rumpler, equipped with two parallel machine guns, cartridge belts of one thousand rounds were provided. The Albatross carried superimposed ammunition strips which fed automatically into the machine gun.

In general utility planes, two machine guns are mounted, one in the front part of the machine, the other towards the stern. The mountings vary, but in general the forward gun is arranged to fire in all directions and is the offensive weapon, while the rear gun fires only in an angle of less than 180 degrees and is the defensive gun. This vertical angle is limited by the fuselage and the wings.

It has been attempted to mount a light cannon in an airplane, but without success. A few planes are equipped with light 37 mm. cannon, but nothing has been gained by it. The bomb is the airplane's high-powered, high-calibered weapon par excellence. Bomb dropping machines are more or less complex affairs, arranged so that one or several bombs may be dropped at a given instant.

The primary requisite of fighting planes is superior climbing power, diving power, and the power to reach the upper fighting levels. Modern warfare has developed an application of airplanes offensively against targets on the ground, when the aviators fly low enough to sweep the targets with machine-gun fire.

Aerial Personnel

In order to acquire and maintain an efficient air force, it is first necessary to establish a competent training force. To this end officers and men should

be selected from the armies in the necessary proportions, depending upon the exigencies of the situation. The training of pilots, observers, and engineers is the most important.

As to the officers and men who are selected to become pilots, it has been proven that any normally constituted man can pilot a modern airship. The new motors give the pilots more confidence in their machines, and the improved construction of fuselages and landing gears makes it easier to land without an accident.

The usual strength of aviation officers maintained in peace time will never suffice for the necessities in time of war. In most armies engaged in the present struggle it has been impossible to pick aviators from among officers. Recourse has been had to the enlisted personnel and even to civilians. When war is declared, the trained peace-time aviators will be used for instruction, to carry out raids, and to manipulate the pursuit planes. With the inevitable casualties their number will decrease rapidly.

In Spain it would be advisable to maintain at all times a trained aviation reserve corps. Three months' training is all that would be required to form these reserve corps pilot squadrons. It is inadvisable to pick officers from the various branches of the service and train them for aviation. This makes the aviation corps an independent branch at the expense of every other branch of the service, or else the tendency is to fill it up with men from one branch only, as has been the case with the French Engineer Corps.

In the first airplanes, the pilot was kept so busy in keeping his plane from falling that he could not perform any observations. It was necessary to carry a second man as observer.

With the advent of pursuit planes in which the pilot operated his own machine gun, it was thought that the observer would disappear entirely. Finally it was determined that the presence or absence of observers depended entirely upon the mission, and that general utility planes should always carry one or two observers.

The modern observer, besides studying the configuration of the terrain, must take photographs, operate the second machine gun, operate the wireless telegraph, drop bombs, etc., and observe and report on the effect of artillery fire. Consequently it is necessary to specialize in training observers.

In making strategic reconnaissances it is well to employ general staff officers as observers, and to prepare them beforehand for this duty. In artillery fire correction, artillery officers should be used, after proper training as observers.

The duties of observers will vary according to the battery whose fire they are observing.

The 7.5 cm. battery will need very little aerial observation and correction of its fire. The majority of the targets against which the 7.5 is used can be seen from advanced observation posts, where the fire can also be corrected.

In laying down barrages, the 7.5 battery is also used. In this case a great number of 7.5 guns will generally be used to cover with their fire a certain zone. Aerial observation in this case is necessary, but one observer will suffice for the entire group of batteries engaged, as the corrections and observations in this case will apply equally to all batteries and guns.

The artillery aerial observer is really the man who directs the artillery fire. He occupies the same position with respect to the group artillery commander that a chief of staff occupies with respect to his general. The artillery observer and the group artillery commander should know each other personally.

Every general officer in command of artillery should have on his staff an artillery fire observer in addition to his regularly assigned staff officers. Further, every regimental adjutant should be trained so that he is capable of making artillery fire observations and corrections from the air.

A case may arise where aerial observation is necessary to correct the fire of a detached 75 mm. battery which is acting independently. In this case one of the artillery regimental observers will ascend with an artillery fire correction plane. Almost any plane can be used in this case.

For the 15 cm. howitzer, the best observation and fire correction service can be established with a captive balloon. In case airplanes are used, the same arrangements will suffice as for the 75 mm. field battery. The 15 cm. howitzer has always been considered by the Germans as a necessary complement to the 75 mm. battery.

For the 15 cm. rifle, the captive balloon will not suffice as the range of this piece is great in comparison with that of the 15 cm. howitzer. Airplane fire correction will be necessary for these pieces.

With respect to mortars, howitzers, and cannon of 30 cm. caliber, all that can be prescribed for these pieces is aerial observation and correction of fire. Whether this is done by captive balloons or airplanes depends upon the local firing conditions in each case.

The author gives the following resumé of the necessities for Spain:

1. It is necessary to create the specialized artillery observers as soon as possible.
2. The commanding officers of artillery groups, general officers, and chiefs of artillery should have a graduate observer under their immediate orders.
3. The lieutenant adjutant of every regiment of field artillery should be a graduate observer.
4. In correcting the fire of batteries of 15 cm. howitzers, airplanes should be used to notify superior officers of fire effect. Fire control should be done from captive balloons.
5. The captain or a lieutenant in each 15 cm. gun battery should be an aerial observer of artillery.

Germany

[German Aviation and the Development of the Bombing Plane. *Memorial de Artilleria,* Mar, '18. From *L'Aerophile.* 1000 words.]

At the end of 1917, Germany had 273 airplane squadrons, as follows:

100 squadrons for artillery fire control.
23 squadrons for bombardments.
110 squadrons of pursuit planes.
30 squadrons of combat planes.

AERONAUTICS—Continued

The latter are used to accompany and protect bombing squadrons.

All factories in Germany which could be used to make airplane parts have been requisitioned by the state and put to work turning out some part, either of the planes or the motors. The planes have been standardized. The rotary motor has been abandoned and now only Mercédès and Benz motors are being built.

The main German effort in this line is toward the perfection of pursuit and bombing planes—especially the latter. The Gotha, the latest type of bombing plane, is twin motored and a three-seater; carries 600 kgs. of arms and projectiles, 500 kgs. of gasoline, and oil; and 240 kgs. of other load. Some Gothas are equipp with three 260 h.p. motors, while others are equipped with six 200 h.p. motors arranged in pairs—one pair to a propeller.

There is also the Friedrichshafen biplane with two 225 h.p. Benz motors, one gondola on each side of the fuselage, thus giving a good field of fire for the three machine guns in the fuselage. Twelve bombs are carried. This airplane follows the Burgess-Dunne system of inherent stability.

The A. E. G. type of bombing plane has been used by the Germans against Allied objectives in the zone of operations, but the Gothas are preferred for long distance bombing flights. The bombs carried by the Gothas and A. E. G. planes can be classified as follows:

The 92 and 11.55 kg. elongated bomb.
The spherical bombs.
Incendiary bombs.

Mr. Caproni calculates that his giant 900 h.p. triplane can drop 1500 kgs. of explosive on Essen, 2181 kgs. on the Austrian naval base at Pola, and 1360 kgs. on Vienna.

Austria

See also
AERONAUTICS—SEAPLANES (Article: "Austrian Ago and Lohner Flying Boats")
ALBATROS BIPLANE

China

[What of China's Air Service? *Scientific American*, Dec 8, '17. 275 words.]

China, it appears, inaugurated her air service in 1913 by placing orders in France for six 80-horsepower and six 50-horsepower Caudron biplanes. At the same time it was decided to build up a large air fleet by adding new units from time to time; and since then slow but steady progress has been made toward this end. In 1913 a home-made machine was constructed at Nanuan, but on the whole the Chinese have preferred to purchase their machines abroad.

The military aviation school is at Pekin. For training purposes Caudron machines are used. This well-known French type of the ante-bellum period is of the tractor design, and in this particular instance is equipped with a six-cylinder, radial, air-cooled Anzani engine developing forty-five to fifty horsepower. The mark or seal of the Chinese air service is a plain five-point star.

During the "White Wolf" operations in 1914, four of the Caudrons were employed by the army. They proved most effective in locating the enemy, thus furnishing a new incentive to the Chinese air service. No casualties to the machines occurred. The rapid development of airplane manufacture in Europe made it inevitable that China should turn to France or England for machines.

France

See also
PAUL SCHMITT AIRPLANE

Germany

See also
DIRIGIBLES—GERMANY
RUMPLER BIPLANE

[Germany's Aircraft. *Independent*, Dec 22, '17. 138 words.]

A correspondent who professes to be accurately informed, reports that Germany now has with her army in the field about 300 squadrons of airplanes, numbering about 2500 in all. Of these, 23 are bombarding squadrons, 40 are "chasers," 30 are protecting squadrons, 80 are patrol squadrons, and 100 are artillery squadrons. In addition there are garrison squadrons, training squadrons and the hydro-airplanes of the navy. Of the 45 Zeppelins which have been built, 27 have been lost, namely: 5 destroyed in Germany, by accidents, etc.; 5 in neutral countries adjoining Germany; 15 in England or on their way to or from England; and 2 at sea. Five of the survivors are out of use, 4 are used as training ships, and 9 are still in more or less active service about the North Sea.

Great Britain

[War in the Air. *Army & Navy Gazette*, Apr 13, '18. 1050 words.]

With the institution of the Royal Air Force we may look for a more intense study than in the past of the possibilities of aggressive operations by our aerial forces. While still continuing to fulfil the duties which the Royal Flying Corps and Royal Naval Air Service have hitherto so successfully undertaken in aid of the other arms, and on behalf of the General Staff—reconnaissance and artillery observation—the new Force will be able to intervene more and more effectually, and, tho of course in co-operation with the general scheme of a campaign, more and more independently each month, and we may be sure that by the time the American armies in their full strength will have begun to act against the Central Powers, the joint resources of the Allies in aircraft will have enabled them to carry out aggressive operations on a really formidable scale. The direction which these operations may take appears at present likely to be along three main lines of action—the bombing of German nerve-centers and sources of supply, the attack of crucial points in the enemy's lines of communication, and the spraying of the advancing masses during an offensive with machine-gun bullets and their harassment by bombs. The bombing

of billets, aerodromes and ammunition dumps, and places of concentration will of course go on without cessation as opportunity offers, but such excellent results have been achieved both in the resistance to the German offensive now proceeding and in a minor, but equally significant, degree in Mesopotamia in pursuit of the Turks, by concentrating the fire from aircraft on roads, railways and bridges over which an enemy's troops must advance to attack, or along and across which he must retire, if repulsed, that we can never in future afford to neglect such an obviously advantageous employment of all the airplanes which we can spare at any time for such a purpose.

[Progress in Aeronautics. By Maj. H. Bannerman-Phillips. *United Service Mag.*, Apr, '18. 3300 words.]

The systematic harassment of German centers of munitions supply, steel works, factories and lines of communication within airplane reach has been proceeding for some months with excellent results. As an evidence of the extent of this work, sixty-five tons of bombs were dropped on various targets between Feb 1 and Feb 22. On Mar 10 a notable daylight raid was made on the Daimler works at Stuttgart, over one and a quarter tons of bombs having been dropped.

These strategic raids were carried out independently of the attacks on lines of communications, ammunition dumps, and billets immediately in rear of the German defensive lines. The Secretary of the Air Council said in Parliament, Feb 21, that bomb-dropping by night and day had become one of the constant functions of the air forces. It is hoped that America will aid substantially in this work in the latter half of 1918. The Liberty motor is now on a quantity production basis.

It is of vital importace to the Allied cause that the raids on German production centers be kept up. The bombing immediately behind the lines is necessary and useful, but the strategic raids will have a more general effect toward ending the war.

Co-ordination with regard to the supply of machines to the Royal Naval Air Service and the Royal Flying Corps is very necessary and is being obtained. Another important item is that the aerial enterprises carried out under the Air Council should not diminish the powers and facilities of the General Staff of the armies in the field to deal with local situations or interfere with the supply of machines for reconnaissance, artillery observation, defense against enemy aircraft, and other local operations.

The medical aspect of flying is important. Rising to high altitudes in brief intervals of time is hard on the human mechanism and brings about heavy nervous and physical strain. It is first necessary to prevent from becoming pilots men who are physically unfit for the work. This requires special knowledge and research, so that the medical personnel must become experts in this line of work. Moreover the pilots must be watched to see that they are fit for work when they go up. Adequate inducements must be offered to medical men to fit themselves for this special work. A special medical service is, therefore, an essential for the Air Service. Each airman costs the government about $4500 and his machine about $20,000. Prevention of 100 accidents per year would save the cost of a special Medical Air Service.

Certain information has been made public with reference to the organization and duties of the Air Council. The Chief of the Air Staff is charged with advising the government concerning the conduct of air operations and upon questions of air policy. He controls the training and development of the Air Force, and determines specifications relative to matériel, disposition of air stations, and general schemes for works and airdromes. The Master-General of Personnel is charged with raising and maintaining the personnel, with discipline, and with arrangements for the Medical and Sanitary Services. The Controller-General of Equipment supervises the production of matériel in accordance with the specifications laid down by the Chief of the Air Staff, and arranges with the Director-General of Aircraft Production for the production of this matériel. The Director of Lands is charged with the maintenance and management of all lands required by the Air Service. Any required buildings are erected by the Administrator of Works and Buildings. The Secretary to the Air Council is charged with general control and co-ordination of Air Ministry procedure, and with the conduct of official business in the Air Ministry.

The Air Ministry controls the distribution of aircraft to the Admiralty and War Office. A weekly conference is held between the Staffs of the Admiralty, the War Office, and the Air Ministry to discuss questions affecting all three. The control of the Technical Department has now been transferred to the Department of the Director-General of Aircraft Production of the Ministry of Munitions.

It is presumed that during the war the President of the Air Council will be responsible to Parliament as well as to the Crown for all that concerns the Air Force and nothing more. Some changes will be required with the advent of peace.

[The Royal Flying Corps. By C. G. Grey. *Air Service Journal*, Feb 14, '18. 2650 words. Illustrated.]

To-day one feels all the more satisfaction in being able to say that there is so little the matter with the R. F. C. that only a search for almost inhuman perfection could find cause for complaint. It is the pilots themselves—and their observers—who are the best, if the unconscious judges of the rest of the Corps. At any rate, one can judge from them and their average attitude of mind whether the state of the Corps in general is as it should be or not. And to anyone who is closely in touch with the pilots and observers the difference between their mental attitude to-day and their attitude at the same period in 1917 and 1916 is absolutely startling.

At the beginning of 1916, thanks to imbecile mismanagement of airplane and engine output at home, the aviators were thoroly depressed. They knew that their machines were outclassed by the German Fokker single-seaters. Tho politicians, in and out of uniform, scoffed at the "Fokker scourge," that scourge was a very real thing to the men who had to meet it. By the spring of 1916, thanks very largely to the agitation in the

AERONAUTICS—Continued

press and Parliament, matters had improved appreciably. After their defeat on the Somme the German authorities naturally made the greatest efforts to pull their Air Service together, and, under General von Hoeppner, great improvements were made, which resulted in the pendulum of superiority swinging back somewhat to their side early in 1917. In the meantime, however, not less strenuous efforts were being made in this country. The new Air Board, with Lord Cowdray and Sir William Weir as its moving spirits, was doing its utmost to repair the mistakes of the past and to overtake the demands of the R. F. C. in the field for more and better planes. In consequence of their efforts the production of aircraft increased to an extent which at any rate resulted in the R. F. C. in the field being thoroly equipped.

For months past those of us who have been in close touch with the people who do the flying have felt the entire change of atmosphere as compared with the black days of the winter of 1915-16, and the somewhat gray days of 1916-17. During the big battles round about Easter of 1917, altho the R. F. C. casualties were heavy, one heard hardly any grumbling about bad supplies or bad quality of machines, and from that time forward the improvement in the whole spirit of the Corps has been more and more marked. Both the old and new hands are far better mounted than they were in the past, as the Hun knows to his cost. Some types of airplanes which were doing good work a year ago are still in use as fighting machines, tho newer machines which are faster and climb higher are being used to greater extent. This also is in accordance with the needs of the Corps, for sheer speed and climb are not everything in air fighting under modern conditions. For certain kinds of fighting quickness in handling is more important than anything else. There is now no waiting for machines as there used to be in the old days.

Whoever may have to wait for new machines at home, the squadrons at the front are kept fully supplied. Apart from the supply of new airplanes from home the R. F. C. abroad has a wonderful system of supplying itself. When a machine is crashed, even sometimes right up in the firing line, its remains are rescued and handed over to the salvage people, who use every scrap of it which is usable. In the case of the R. F. C. a highly organized salvage system has been in use for a long time. One has heard in this country of brand new machines being delivered minus engines—after being subjected to all the usual rigorous inspection and procedure and then being solemnly burnt, to save housing room. Everything saved is used to the best possible advantage. Meantime the point is that the nation's resources are very much more economically used on active service than they have been at home, tho one hopes that under his reorganization of aircraft production Sir William Weir will institute a system such as that which has been so long in vogue on active service. All that has been said about the reconstruction of airplanes and the salvage of airplane parts holds equally good in reference to engines, instruments, guns, cameras, and everything else connected with airplanes.

[Progress in Aeronautics. By Major H. Bannerman-Phillips. *United Service Magazine,* Sept, '18. 850 words]

The organization of the Royal Air Force is based on four years of war experience at high pressure, during which time Great Britain has augmented her air force from 80 planes at the beginning of the war to the point where it can be stated that in the past four years she has lost 1000 planes and accounted for over 4000 enemy aircraft.

The Royal Air Force was formed Apr 1, 1918, by the consolidation of the Royal Naval Air Service and the Royal Flying Corps, and is under control of the Air Ministry. The Air Ministry supplies air contingents to the various theaters of war where they are under the supreme military or naval commander. There is also an Independent Air Force which operates directly under the Air Ministry. The production of air matériel is under the Minister of Munitions, who has a special department to attend to the needs of the Air Ministry.

Lighter-than-air craft remain under the Admiralty, the Air Minister supplying the personnel.

Under the Air Ministry are three Main Committees:

1. The Advisory Committee, which engages in aeronautical research work, etc.

2. The Inventions Committee, which investigates all inventions submitted by the public and develops those which have advantages.

3. The Accidents Committee, which investigates all accidents which require it.

Italy

See also

AERONAUTICS—SEAPLANES (Article: "The Italian 'Macchi' Fighting Flying Boat")
S. V. A. AIRPLANE

United States

[Building American Aviation. By Col. H. H. Arnold, Signal Corps, U. S. A. *Scientific American,* Dec 1, '17. 2100 words.]

Five months ago, Congress made the generous appropriation of $640,000,000 for the establishment of aviation in this country. Within that time the groundwork of an enormous Government organization has been laid, a new science built up, a new industry, new types of skilled men and machines, new theories of progress and development. All this has been done quietly, unseen by the general public, a process as unspectacular yet as vital and as sound as the long effort in laying the foundations for a skyscraper.

When war came to the United States, aviation hardly existed in this country. There were barely a few score flyers, a hundred or so second-rate machines, practically neither airplane industry, training system nor general engineering knowledge. The appeal from abroad, however, was desperate and the call sent out from Washington struck American imagination as almost no other phase of the war. In 44 days from

the launching of the new program, Congress had responded with the largest single appropriation ever made, $640,000,000.

The task so spontaneously laid upon the Government was enormous. Foreign nations, driven almost to genius in airplane development by the lives which hung in the balance, had developed their aviation science by leaps and bounds. It is a fact that on April 6th, America, the birthplace of aviation, had been left so far behind that its factories received contracts only for training planes by the Allies. Aviation in this country was yet to feel the stimulus of a desperate struggle of nations.

The new program called immediately for a great number of highly selected men, for methods of training them along highly specialized lines, for the design and construction of schools, warehouses, etc., for the design of planes, engines, magnetos, barometers, cameras and scores of other accessories, none of them ever before manufactured on a large scale here, for the stimulation of industry in all these directions, and for a great general staff organization. All this had to be done in the rush of other war work, in the tremendous stress and strain upon American man-supply and American industry, in a time when shipping, ordnance, quartermasters' supplies, cantonments and the new line armies of a million men were making their demands on America's reserve capital.

The immediate problem was personnel: to get enough men, and to get the right kind of men. The Allies needed planes and engines badly but they needed aviation specialists, mechanics as well as pilots and observers, even worse. Too many men of the right sort will never be obtained for air work.

Every possible care has been and is being taken to keep this personnel up to standard, as French experience shows that only the highest quality of men can be entrusted with the responsibility of putting their machines oven the line. To get such men, to pick from America's millions those best qualified for the air service, has in itself been one of those unspectacular, unseen problems which have gone so far toward laying the foundation for the American Air Service.

For flyers, men of cool-headedness and responsibility, well educated, with strong lungs, heart and sense of balance, are being selected. For enlisted men, radio operators, mechanics, etc., the same specialized standards have been set. Naturally, the difficulties in building up a large force at emergency speed have been great, and while there are tens of thousands of men suitable for the work, the trouble has been to locate them immediately. We are frank to admit that we are not now getting enough of the right sort of men with the rapidity wished for, mostly because it takes time to establish contact with those desired.

But the initial getting of personnel is only the start of the problem. Every man, tho specially selected, must undergo an intensive training to focus his specific ability on aviation problems. During these past months, schools have been built, courses of study mapped out, instructors obtained and pupils set to work in no less than nine distinct branches. There are now operating schools for pilots in three degrees —ground work, preliminary flying, and advanced flying; for observers; for balloonists; for radio operators; for photographers; for supply officers; and for mechanics. This has taken time and effort, but it has created a permanent addition to America's resources.

Take the mere building of the schools themselves. The qualifications for an aviation school site are most exacting. Fields possessing these had to be selected, leased, cleared of woods and brush, drained and leveled; hangars, barracks, parks and railroad connections had to be built; and all the other problems of housing hundreds of men had to be met. The first field was finished in six weeks, the second in eight, and the others as fast as they were needed to take pupils.

Those early weeks of construction work were not lost, however. Men were actually under instruction while the flying schools were being built. A number of large engineering universities co-operated with the Government in establishing preliminary ground school courses, and upon the graduation of the first class from those schools the first new flying school was ready for the second step in training. Here the prospective pilot has a thoro course of preliminary flying instruction, after which he goes to an advanced school for his final acrobatic and squadron formation work. The care with which the student has been selected and surrounded is reflected in the fact that only six air fatalities have occurred in a program for training thousands of new and inexperienced men.

In all this work America has been splendidly aided by the Allies. The courses of instruction thruout have been drawn up largely on Allied experience and in consultation with Allied officers. Scores of the best airmen of England, France and Italy have been in this country for months, some at Washington, the majority out on the fields in direct contact with this country's new airforce. Similarly, schools in Allied countries have been thrown open to American aviators in the most whole-hearted way.

So much for personnel. Manufacture presents the other great problem. While the allies are better supplied with machines than with men, the whole American ambition will be attained only when quantity production of airplanes is realized here. To date progress has been very quiet and unspectacular, but none the less sound.

When war broke out there was practically no airplane industry. A few firms, mostly experimental, were working along silently in separate grooves on the problem, which had hardly touched the public imagination and which had interested the Government to the negligible purchase of less than 200 machines in the whole history of the science. Capital was dubious and knowledge of the engineering advances made in Europe, limited.

The Aircraft Production Board, bringing in business men of the widest industrial experience to co-operate with Army and Navy experts, was the immediate answer to the problem of stimulating something out of

AERONAUTICS—Continued

this near vacuum. Engineering commissions at once crossed the ocean both ways and a general stock taking was had of America's great potential resources. Three distinct needs were evident: to increase the flow of raw materials for airplane manufacture abroad; to do as much for manufactured parts; and to build up an industry here which should produce planes by the thousands, not by the score.

It is easy to build up a new airplane or engine but it is a very different thing to build either in quantities. Even supposing the complete planes are agreed upon, it will take a forging company, for instance, 10 weeks to develop a die for quantity production of cylinders, and several weeks more to develop the steel treatment necessary afterwards, slow, unspectacular, but vitally essential work.

It was problems like these that America set itself to meet. Quantity production of airplanes, regarded as chimerical abroad, had to be worked out here as quantity production of automobiles had been. Factories had to spend months of quiet effort in developing welding machines, valve guides and other manufacturing essentials before results could even begin to appear.

One of the first advances made simultaneously with this tooling up of industry, has been the co-ordination of the resources of the Allies. Competition between England, France and Italy in the purchase of spruce for instance, had jumped the price to $205 per 1000 feet. Here, as in other items, the United States has made itself the general purchaser in this country for the Allies, cutting prices in many cases, as in spruce, as much as 50 per cent, and at the same time increasing the supply. Similarly, the Government has brought about a closer agreement among all four nations so that each shall increase its production of what it best produces and rely on its allies for what they best produce.

Another foundation stone, the standardization of parts, has also been laid during these past months. Naturally, quantity production was impossible so long as each manufacturer had his own sized nuts, bolts and various other parts. During the past months, however, standard specifications have been adopted in co-operation with the Allies so that the riot of odd sized parts has been brought down to a standard in each line.

The great development in this line has been, of course, the Liberty Motor, called by Secretary Baker, "the greatest single achievement in the war," a motor containing the best engineering principles the world over, capable of unlimited production, already in possession of the American altitude record. Factories have already been completed for its manufacture, the first deliveries are due shortly, and the possibility has opened up that the engine will be adopted by the Allies also.

The production of planes has not been so quickly solved. The United States, while stimulating the production of training planes to the great extent required, spent the first few months of war in getting the last-minute details from abroad both by cable and in samples. Supremacy abroad has swayed back and forth with whichever side happened to have brought out its latest model, and the American program has had to change almost over night to keep pace with the changes there. Types have been adopted and are now in process of manufacture in all the fighting, reconnaissance and bombing planes, but are still subject to constant modification as betterments come out. To meet these problems, the Aircraft Production Board, which was under the authority of the Council of National Defense, has been organized into the Aircraft Board, based on Congressional authority, reporting to the Secretaries of War and the Navy and having general advisory powers over the whole program. Three of its civilian members and several other employees have been taken into the Army and have built up the Equipment Division of the Aviation Section, now occupying three whole floors of a large office building and responsible for the spending of several hundred millions of dollars. From these sources, aided by American officials abroad, Allied officials here, the Bureau of Standards, the National Advisory Committee on Aeronautics, etc., are coming in the threads which are building up the airplane industry in this country.

During these past five months, it may be said that the United States has received the very best information won by the Allies in three years of desperate struggle, has established personal contact with Allied specialists here and abroad, effected much greater co-ordination of joint resources, tooled a new industry up to the point of quantity production, solved the aviation Nemesis of the motor, brought itself up to evens in the plane program, and established a great Government aviation headquarters. The foundations have been laid firm and secure and the development should be rapid.

A great change has thus been effected in American life. If the war were to end tomorrow, it would leave America secure in aviation. Hundreds of flyers have already been trained; facilities for training other thousands would be on hand; and the industry would be here to meet the manufacturing problems. The $640,000,000 has already proved a profitable investment to the United States, for it has added a science which will become part of America's best national capital. One who has seen planes fly 150 miles an hour, attain to nearly five miles in altitude, or carry 25 passengers, cannot but feel that the solidity of its development not only is justified by the bitter exigencies of war, but is part of America's future progress.

[United States Aircraft Production Reviewed and Analyzed. By Howard E. Coffin. *Flying*, Feb, '18. 1960 words. Illustrted.]

The American Aircraft Program:

1. The United States to establish and maintain a great system of training stations, adequate both in ground schools and flying schools, to provide preliminary training for the personnel schedule. Twenty-four great training stations were authorized under the bill to be built in accordance with the requirements scheduled in the air-service program. Nine grounds

for the preliminary training of the flying personnel in technical matters were planned at nationally known universities.

2. To accomplish an international standardization in aircraft materials, in detail of design and types, and to achieve such co-ordination of effort as would concentrate the manufacturing facilities of the various allied countries upon the minimum number of types of those machines for which the producing equipment was best fitted.

3. To construct primary training machines of quality and quantity approved by the Joint Army and Navy Technical Committee.

4. To provide, equip, and train personnel for flyers and mechanics in accordance with schedule recommended by the Joint Army and Navy Committee.

5. To provide raw and semi-finished materials and finished parts, including motors, to insure the consummation of the augmented allied aircraft-building programs.

6. To provide for the equipment of the American forces in France for the period of January to June, 1918, in large part by purchase of fighting machines manufactured in allied countries and to supply the machine tools and raw and semi-finished materials necessary to insure their production.

7. To provide complete service machines, including combat and bombing types, for American need after July 1, 1918, and for such shipment of the finished product overseas as tonnage might permit.

In a country where one great industry produces a million and a half motor cars per year, the fabrication of a hundred thousand planes might seem easy, but actual figures based upon three years of practical experience in the war show that there are now between 40 and 50 men of the auxiliary services required for each active machine at the front. Again the problem of proper housing behind the battle lines in Europe of such great numbers of planes as are carelessly discussed may well be left to sober thought.

The feat of getting the 12-cylinder U. S. A. or so-called Liberty engine from the first scratch on paper in June to the beginning of production of quantity manufacturing tools in November is one never equaled even among the spectacular performances of the American motor-car business. The slowness of the Government departments in paying for the goods delivered has been a contractor's complaint of long standing. For sixty days past, in the disbursement of millions, no Signal Corps account properly presented has remained unpaid longer than one day after the delivery of the material. There has been established in Paris under the direction of the Aircraft Board, a joint Army and Navy aircraft committee to co-ordinate the activities of Army and Navy in foreign territory and to form a direct channel of contact between the interallied aviation committee and the Aircraft Board in Washington. The board has arranged with foreign Governments for a free interchange of manufacturing rights and patents governing aircraft for the duration of the war.

[Report on Aircraft Production Inquiry. *Official Bulletin*, Nov 6, '18. Attorney-General Gregory's Summary, 5000 words, Judge Hughes' report 85,000 words. Tables.]

(Note.—Much of these reports covers ground of no military interest. Some of the facts reported are important, and these are summarized, without attempt at continuity.)

From Attorney-General Gregory's Report

Of the $691,851,866.47 cents appropriated for all aviation purchases, contracts estimated to require $474,910,706.55 had been let here and abroad, but the actual disbursements to June 30, 1918, were:

Production in this country	$106,741,490.77
Production abroad	25,605,074.31
Experiment and development	1,697,830.19
Total	$134,044,395.27

Up to July 31, 1918, there had been acquired under foreign contracts 1617 training and 1512 service planes, a total of 3129 planes and engines.

Deliveries in this country to July 1, 1918, were:

Planes:	
Elementary training	4,572
Advanced training	1,046
Service	553
Total	6,171
Engines:	
Elementary training	7,662
Advanced training	2,579
Service	2,392
Total	12,633

From July 1 to Oct 11, 1918, the deliveries were:

Planes:	
Elementary training	615
Advanced training	1,091
Service	1,797
Total	3,503
Engines:	
Elementary training	2,594
Advanced training	1,900
Service	7,545
Total	12,039

Counting the 3129 machines procured abroad, the total production and purchase to Oct 11, 1918, was 12,803 airplanes and 27,801 engines.

From Justice Hughes' Report

The Act of July 9, 1918, made a new appropriation of $884,304,758 for the Air Service.

Sixteen hundred SJ-1 training planes were ordered and delivered prior to June 30, 1918. This type of plane was condemned as dangerous in June, 1918, because of the unsuitability of the Hall-Scott A7a motor used with it. There was no defect in the plane itself.

The Bristol Fighter was condemned as unsafe in July, 1918. Two thousand of these machines had been ordered. Only 27 had been delivered prior to cancellation of the order, but a large amount of work was in progress.

AERONAUTICS—Continued

When we (U. S.) entered the war, approximately 100 airplanes had been delivered up to 1917. There were few flyers and fewer still aviation engineers. The airplane industry was in its infancy.

The Joint Army and Navy Technical Aircraft Board made a report on May 22, 1917, embodying recommendations for the purchase of 700 JN-4 advanced training planes, with Curtiss OX-5 engines and spares, 100 Gnome engines, for the procurement of working drawings and model machines comprising the Sopwith, Spad 1-place pursuit, S.E.-5 1-place pursuit, Sopwith 130 hp. Clerget 1-place pursuit, D.H.-4 2-place reconnaissance, and B.E.-2d 2-place reconnaissance airplanes, also White Gnome pusher, two types of Fairey, and Farman 150 hp. Hispano-Suiza seaplanes. Engines recommended for procurement as models included Lorraine-Dietrick 250 hp., Clerget 130 hp. Hispano-Suiza 300 hp., Rolls-Royce 270 hp., B.H.P. 200 hp., and Gnome Mono-soupape 170 hp.

On May 23, this board recommended a building program designed to supply the needs of the U. S. Army to July 1, 1918, comprising 3500 JN-4 OX-5; 1750 DeH-4, Rolls-Royce or equivalent; 600 SE-5, Hispano-Suiza; 600 Spad, Hispano-Suiza; 600 Sopwith, Clerget 130. The number of engines recommended was double the number of machines, making a total of 7050 planes and 15,100 engines, the latter including a stop-gap order for 1000 A-7a engines for JN14 planes. If the United States was to be called upon to train foreign flyers in addition, the numbers were increased to 9900 planes of the various types and 19,800 engines.

Orders were placed in France for 875 training planes complete, and 5000 service planes and 8500 engines of various types, and in Italy for 500 S.I.A. 6-B planes and 200 to 300 Capronis. Up to Feb 1, 1918, only about 600 planes had been delivered on orders placed with the French Government, due to non-arrival of raw materials.

Lack of planes in France led to serious delays in the training of American cadets abroad.

In a cablegram received from France, Oct 5, 1917, occurred the following: "Useful loads increasing so rapidly here that engines now in the United States are not considered powerful enough meet requirements. Two-place pursuit airplanes considered most urgently needed airplanes next year," and in a cablegram dated Nov 8, 1917, "Situation here has changed much during three months, since original recommendation and continues changing constantly. Following general principles appear clear to us: First. Single-seater fighter will probably become obsolete general use next year, altho small numbers will always be used special purposes. Recommend you to produce number already actually under contract and started. Believe we can obtain here all this type required future above number actually under contract here and America. This applies both single-seater fighter airplanes and engines. Second. Two-seater fighter airplanes with stationary engines will supersede single-seater. Four hundred horsepower probably sufficient next six months, after that 500 horsepower necessary. This summarizes cables already sent you."

There were many difficulties in the way of quantity production, among them that of changing design, but "we have not as yet (date of report Oct 25, 1918) sent from this country to the battle front a single pursuit or combat plane, as distinguished from the heavy observation or bombing planes, and, after giving due weight to all explanations, the fact remains that such pursuit planes could have been produced in large quantities many months ago had there been prompt decision and consistent purpose." There was also delay in the building of Handley-Page and Caproni planes .

The result of the abandonment of the Spad, was to leave us, until recently, without any program for single-seaters, and service planes limited to the De Haviland 4s and Bristol Fighters. The Bristol Fighter as re-designed to take the Liberty motor proved to be a failure and was discarded. The motor was much too powerful for the plane.

Nothing was left of last fall's program except the De Haviland 4s. After various defects were remedied, they are being successfully used as observation and bombing planes, tho because of certain limitations later and improved types are to be provided. The De Haviland 4 has not enough maneuverability to be used as a pursuit plane.

Engine types and possibilities of production in the United States are discussed. The history of the Liberty engine is given. The Packard Co. had designed an aircraft engine. The drawings were taken to Washington in the latter part of May, 1917. The design was not deemed adequate for the work on the western front. Greater power and less weight per horsepower were demanded. To meet these demands, Mr. J. G. Vincent of the Packard Motor Car Co. and Mr. E. J. Hall of the Hall-Scott Co. in a few days designed a new motor embodying to a considerable extent the features developed during the Packard experimental work. A full size operating model of this motor was delivered and sent to the Bureau of Standards for test July 3. The first efforts looked toward an 8-cylinder motor. About August a 12-cylinder motor was decided upon. Minor changes were found necessary in production. The crankshafts, connecting rods and bearings of the first thousand engines were too light, producing a dangerous condition. Difficulties were encountered in lubrication and in the radiators. These were subsequently obviated. The Liberty engine is conclusively established to be a great success for observation and bombing planes, but is too heavy for pursuit planes. It has found high favor with the Allies. The British Air Ministry, under date of Sept 27, 1918, reported the Liberty engine "at least as good as the Rolls-Royce in identical machines."

The general average of accidents in training for all the camps in the United States is one accident for every 3200 to 3600 hours of actual flying. One school had one accident for every 1900 hours, and the best one accident for every 4800 hours. It is believed that we have about half as many accidents as the British and French for equal amounts of flying.

The first De Haviland 4 was shipped from Dayton, O., Feb 5, 1918. Up to May 2, only 13 had been shipped abroad. June 25 advices were received from France that there were serious defects in the planes that had

been received. Up to Oct 11, 1918, 2350 De Haviland 4s had been delivered.

Liberty engines were scheduled to be completed beginning in November, 1917, with 55 and reaching a maximum production of 4725 during the month of May, 1918, the total schedule calling for 22,000 engines, final deliveries in November, 1918. Of these, 6000 were to be built by the Lincoln Motor Co., 6000 by the Packard Motor Car Co., 3000 by the Nordyke and Marmon Co., 5000 by the Ford Motor Co., and 2000 by the General Motors Co. Actual deliveries to Oct 11, 1918, were: Lincoln Motor Co., 2787; Packard Motor Car Co., 3864; Nordyke and Marmon Co., 157; Ford Motor Co., 1868; General Motors Co., 1013, a grand total of 9689. Deliveries were increasing rapidly at the close of the period, Oct 11, 1918. Contracts have recently been let for the Liberty 8, but no deliveries have yet been made.

Accurate drawings and specifications are essential to the production of airplanes. This condition has never been met. Other difficulties leading to delays in production were lack of knowledge and experience incidental to the creation of a new industry; defective organization of the Signal Corps; lack of information as to the equipment required for service planes; changes in design and equipment of service planes; conditions in manufacturing plants (lack of experience, absence of mechanics familiar with class of work required, defective organization, and lack of efficiency); and changes in the Liberty engine. Each of these subjects is discussed at some length. Respecting the latter, it is stated that there is little ground for criticism concerning loss of time in perfecting the Liberty motor. "The difficulties were inherent to the task and the task itself worth while." Other motors might have been put in production, but could not have attained quantity production any sooner than was done with the Liberty motor. Nor could it, making reasonable allowance for experimentation, have been expected to reach quantity production sooner than it did. In any case it reached production such that by May 4, 1918, there were 778 Liberty motors and only 36 De Haviland 4s and no other planes on which to use them.

The actual cost in manufacture of the Liberty motor appears to be about $3200. In the original contracts with a fixed profit and participation in savings under an estimated or bogey cost, the profits of the contractors were large. Later contracts have been put upon a fixed price basis of $4000 per engine.

(Matters treated in the remainder of the report are in general not of military interest, being concerned with waste, labor, labor cost, employment of alien enemies, materials, overhead charges, purchase of the General Vehicle Co., plant, certain contracts for mahogany, and sabotage.)

The mahogany contract discussion discloses a decision of the production engineering department thru Prof. J. S. MacGregor, head of the physical testing department, Columbia University, authorizing the use of the following woods for combat propellers in order of preference:

Black walnut.
True mahogany (Honduras).
Cherry.
Quarter-sawed white oak.
African mahogany.

The discussion of the mahogany contracts had hinged largely upon the question of the use of African mahogany for propellers.

—Accidents

[A Three Years' Flying Experience. By Capt. B. C. Hucks, R.F.C. *Aviation*, July 15, '17. 5800 words. Illustrated.]

The past three years, altho normally a short space of time, yet measured by the advance of aviation, has been a veritable lifetime. I think that I am right in saying that thru the war aviation has advanced more than it would have done in eight or ten years of peace conditions. In fact, the rate of improvement of aircraft is so fast, the pace so alarmingly rapid, that it is almost impossible for manufacturers to keep pace. A pilot has only to take a short flight in a 1914 type machine and then to fly in a 1917 pattern as a comparison to really appreciate the colossal advance. During the past three years the first marked improvement, to my mind, which asserted itself was the inherently stable machine, attained by such slight alterations as sections of elevators and planes that it required an experienced eye to detect a stable or unstable airplane when standing together. Then came the synchronized timing gun gear, which enabled the machine guns to be fired thru the propeller on tractor machines. The device was really so simple that it is hard to realize why it was not discovered before. By improvements of engines and the increase in horsepower more than by improvements in the machines the present day performances are obtained. The very efficient freak machine has yet to make its appearance.

Crashes are mainly due to three causes, *viz.*, engine failure, faulty piloting, and faulty machines. Engine failures are responsible for most of the crashes, often because of the unsuitability of the landing ground at the pilot's disposal. In my experience in testing hundreds of new machines it has been demonstrated that it is seldom the serious defect that lets one down, it is nearly always due to a small detail. Dirt in the gasoline accounts for the engine failures in a great many new machines. Another cause of engine failure which might easily be guarded against is that gasoline cocks in many cases have no definite locking device to insure that they remain in the open position during flight, consequently they are liable to vibrate to the off position. Errors in judgment or faulty piloting cause nearly as many crashes as engine failure. A most conspicuous error made by even experienced pilots is losing flying speed on a turn which starts a side slip and given sufficient height terminates in a nose dive or the more serious predicament of a spin. I have found that most of the later type machines can be stalled without any risk of side slipping, provided that they are kept in a straight course and laterally level, as they will automatically drop their nose as soon as the speed becomes so low that the elevators become

AERONAUTICS—Continued

ineffective. A spin is the extraordinary turning movement that some machines only too readily take up after being stalled on a turn or being turned too flatly even with plenty of flying speed. This is due to the machine suddenly meeting the air a great deal out of the parallel with its longitudinal axis either thru side-slipping, skidding or yawing in the air. No matter how high one is if one tries to pull out in the normal way, it will remain out of control. If the controls are abandoned the machine will come out on its own accord, but the quickest way to come out of a spin is to straighten the rudder and shove the elevator forward. A clean nose dive will then result out of which the machine can easily be pulled. Errors in judgment which are made in landing account for crashes galore but they are seldom more than a small matter resulting in little more than a smashed landing chassis. Accidents due to faulty construction are fortunately rare for when they do happen they are often fatal. Constructional failures can sometimes be traced to damage inflicted by bad landing. This weakens the machine in the reigon of the tail skids and subsequently the tail gives way under stress while flying.

Personally I consider the nearest equivalent to the art of flying is that of motor car driving; a person who thoroly understands and can drive a car really well should possess the qualities for driving an airplane. Time and material would be saved if the modified penguin were used for primary training. A penguin is a machine of low power that is incapable of getting off the ground, and designed solely for taxi-ing over the ground. The best type of airplane to use for instruction in actual flying, and the question as to whether it should be stable or not, are very debatable points. I do think, however, that the less efficient, within certain limits, the early training machine is the better and sounder will be the elementary knowledge and experience gained by the pupil.

There have been a great many fatal accidents during the last three years entirely due to flying thru the clouds. On a very cloudy, windy day I set out to do a test climb to 10,000 feet on a late two-seater type. I had often, on previous occasions, succeeded quite comfortably in reaching this height in spite of the clouds by pushing up thru and reaching the bright sunshine above, and after having reached the desired elevation, coming down thru the clouds, having flown by compass and time. On this day the air was gusty and we ran into a dense rain cloud at 1200 ft. which still continued on beyond 5000 ft. The compass began to swing and efforts to check the compass made it swing the more. The air speed then rushed up far beyond flying speed and all efforts to check it only slightly decreased the speed. Then the rudder was tried and the speed went back to zero, there was an uncanny feeling of being detached from the machine and I knew we were literally tumbling about in the clouds. All efforts to assume a normal attitude were unavailing until we emerged from the clouds almost upside down. Assuming control then was an easy matter. The most marked development in the modern machine is its extraordinary capacity for climbing to great altitudes in short spaces of time. At the beginning of the war the service machines used to fly at altitudes of about 4000 or 5000 feet. To-day altitudes of 20,000 feet are reached. Unless some provisions are made for blanketing the radiator surfaces at great heights it becomes far too cold for efficient running. Cases are known of the water freezing on a descent from a great height with serious results. I have found that the effect of the rarified air at about 10,000 ft. is slightly felt. Breathing becomes shorter and quicker, there is a curious oppressive feeling and a bulging sensation of the head. I am told by a medical friend of mine that there is risk of a sudden collapse and oxygen should be used whether the aviator feels fit or not.

[The Medical Aspects of Airplane Accidents. By H. G. Anderson, M.B., *Aviation*, Mar 15, '18. 4400 words. Illustrated.]

In the early days of flying there were necessarily many accidents, owing first to structural weaknesses in the airplanes, and secondly to the fact that the pioneer pilots had to experiment and were mostly unacquainted with many of the factors governing aerial navigation. As the war advanced and the importance of aviation was recognized more pilots were needed, and the methods of teaching had to be accelerated; after a few hours' dual-control instruction pupils were sent off to do their first solo flights. Naturally many more accidents occurred, and as nowadays tuition is on faster and more powerful airplanes, so have the number of accidents increased. An attempt has been made to classify accidents at one station covering a period of six months. During this time 4000 hours' flying was done, consisting of 9000 flights, and during that time 58 airplanes were wrecked or crashed. Fifty-eight crashes in 9000 flights represents one crash in every 155 flights. In these 58 crashes 16 men were injured, which is equivalent to 28 injuries in every 100 crashes, or one pupil injured in every 560 flights.

The causes of airplane accidents are: (1) defect in the airplane; (2) error in judgment in flying; (3) "loss of head"; (4) brain fatigue or lethargy; (5) fear; (6) physical illness; (7) unavoidable causes.

Defect in airplane implies mechanical failure of some part of the airplane, and can be subdivided into (a) breakage in the air and (b) engine failure. Error in judgment in flying is the commonest cause of airplane accidents. This error may occur in getting off the ground, in the air, or on landing. It is difficult to estimate and account for these errors of judgment. In some cases it may be due to under-instruction. In other cases, even after prolonged instruction, the pupil may still misjudge distances, and on examination one occasionally finds that his standard of vision is below normal; but on the other hand, he may be found physically fit, with normal vision and good balancing power. In these cases it may be a case of delayed reaction time.

Loss of head occurs frequently in a greater or less degree and accounts for a fair proportion of accidents. In flying, seconds and parts of a second count enor-

mously, and may mean all the difference between safety and danger. After actual loss of head there is seldom time to correct the error made. As examples of loss of head in the air the pupil in an emergency may move the throttle the wrong way, may keep his engine full on when he should throttle down, or may switch off his engine at a moment when he requires all the flying speed possible. In contradistinction to loss of head, the pupil in brain fatigue reaches the stage where he has neither the power to reason, decide, nor act. A state of mental inertia supervenes. After a careful study of 100 of the first solo flight confessions of pupils and of many pupils who have had crashes, I am convinced that brain fatigue is a cause of a fair proportion of accidents. As a rule, if it occurs, the pupil, even should he escape injury, soon gives up flying.

Fear, at least in a degree sufficient to disturb one's flying, is rarely experienced in the air on the first few solo flights, whatever the sensations may be before going up or in the intervals between flying. The mind is far too much occupied and concentrated on details of flying, watching the various instruments that record air speed, height, levels, and engine's revolutions and in judging position and direction in the air relative to the ground. In the series of crashes under consideration none was attributable to physical illness. Flying on an empty stomach may cause faintness in the air. From time to time unavoidable accidents arise. Every precaution is taken at a flying school to prevent collisions in the air or on the ground. Set signals are made with regard to the direction of circuits and landing areas for different flights. Some of the errors which the pupils may make in getting off are raising the airplane's tail too high, slewing to one side, or getting off with one wing down. In the air a pupil may lose flying speed or stall, or may sideslip or spin. The sick-bay or dressing station should be in full view of the aerodrome, with a look-out man supplied with field glasses always on duty during flying hours. Should the dressing station not be situated on the aerodrome, the former should be connected by telephone to the look-out man, whose position commands a good view of the flying area. The look-out man leaves his post and proceeds to the scene of accident, taking the wheeled hand stretcher, on which is carried a first aid dressing bag and emergency tool kit case. The latter consists of an oblong box containing the following:

1. Two crowbars.
2. Two strong wire cutters.
3. Saw.
4. A long stout knife.
5. A hammer.
6. Strong cloth cutting scissors.
7. A fire extinguisher.

An injured aviator should never be dragged out of a crash unless in the case of fire, but rather the wrecked machine should be cut away from him. In many cases this prevents simple fractures from being converted into compound ones. Two sick berth attendants go with the ambulance, and with them is a bag containing the following articles: (1) Morphine solution and two Wildey's hypodermic syringes; (2) A bottle of chloroform and face mask; (3) Brandy; (4) A bottle of sterilized water; (5) Six first aid field dressings and slings; (6) Picric acid dressings; (7) A tourniquet, cloth cutting scissors, and a knife.

Officers and flight mechanics sent to the scene of accident should be trained in first aid with special reference to airplane accidents. The injuries sustained are akin to most high velocity accidents, but are usually more severe, as greater speed is used in aviation. They are composed of:

1. Injuries due to crushing, where some part of the pilot's body gets crushed between the parts of the wrecked airplane.
2. Injuries due to collision with the ground, as when the pilot is thrown out or hits the ground with his head in turning over with the machine.
3. Injuries due to impact with different parts of the airplane, as when the head is violently jerked forward and strikes the edge of the nacelle on the airplane's impact with the ground.
4. Injuries from fire.
5. Drowning and immersion effects in seaplane work.
6. Suspension effects, as when the pilot is suspended head downward in an overturned airplane and is unable to loosen his safety belt.

With regard to the use of the safety belt, endless discussion has taken place among aviators. My own opinion is that before leaving the ground all aviators should see that their safety belts are fastened and should be familiar with the method of their quick release. The belt should never be undone in the air. Certainly if the airplane catches fire in a crash little hope can be entertained of the pilot if he be strapped in. Safety for him depends on his being thrown out clear of the machine. A narrow belt is to be condemned. The ideal safety belt should be broad and resilient, attached to the frame work of the airplane and not to the pilot's seat. Safety helmets are of undoubted value in school work and should be worn by all pupils. They should fit properly and not be dislodged whilst flying.

Most aviators wear goggles, but there are some who prefer to fly without them. I know of one instructor who, after a year continuously instructing pupils and wearing no goggles, began to suffer from a form of conjunctivitis.

Accidents under dual control are not common, as the instructor has usually time to correct in the air any of the pupil's errors in flying. In two years of school work I have only seen three fatal accidents occur in 200 crashes. Four deaths occurred, of which three were instantaneous and one after four days. All were due to multiple injuries.

—Armament for Airplanes

[German Technique in Aerial Armament. By Jean-Abel Lefranc. *Air Service Jour.*, Feb, '18. 3500 words.]

Victory in aerial warfare, as in warfare on land and sea, consists in preventing the adversary from executing his designs either by preventing him from continuing the fight or destroying his matériel and personnel until he can no longer resist.

AERONAUTICS—Continued

Aerial fighting consists of a series of actions, by which the combatants endeavor to obtain from their matériel and arms the best possible use to destroy the power of the enemy, who on his side tries to secure the same from his matériel. The actions, which have as their goal the choice of most favorable time, best position, most powerful battle formation, etc., are the elements of aerial fighting tactics.

The deeds which result from the qualities of the airplane, armament, speed, maneuvering ability, altitude, etc., are the elements of technique.

These tactical and technical elements of aerial warfare constitute two kinds of factors, which, altho quite different, are intimately connected.

The battle commences with a series of tactical actions by means of which the assailant tries to attack his adversary by securing the best chances for himself; such as surprise, advantage of greater height, group attacks, attacks from rear, etc. The combat terminates thru the technical contest between the two battleplanes until one or the other is destroyed or takes to flight. It is evident that the preparatory tactical actions of a combat cannot be executed unless the technical characteristics of the airplane permit it. In order to permit its pilot to gain all tactical advantages the airplane must possess speed, armament, maneuvering ability and quick climbing. One of these technical superiorities need not result in any tactical advantage, for instance, a 37 mm. rapid fire gun was carried by the Voisin gunplanes but having little speed or manageability, the enemy airplanes profited by their speed and manageability to attack this gunplane without placing themselves in its very limited field of fire; their superiority of altitude permitted them to climb 500 meters higher and decline combat.

The technical elements are identical for all planes of the same type, but their utilization in combat varies directly with the knowledge that each pilot may have in regard to each particular case. The good usage of tactical elements depends to such an extent upon their intelligent application by the pilot that one has often seen planes, inferior from the point of view of technique, armament, manageability, etc., obtain, due to the ability and courage of their pilots, real tactical successes over quicker, better armed and more manageable adversaries.

For a battleplane, the four large factors in order of importance are speed, manageability, armament and altitude.

A spotting plane, a photographic plane, a small bombing plane, a protecting plane, which because of their specializations cannot be fast enough to avoid combat, should be conceived to possess in addition to their tasks, technical superiority in defensive armament; the manageability and speed factors become elements of lesser importance than in the case of a battleplane. The heavy night bombing plane requires quite different technical qualities, such as great bomb capacity, radius of action, landing ability, etc.

The actual speed of the French and German pursuit planes varies between 115 and 125 miles per hour. This speed could easily be increased if the planes did not require a plane area large enough to raise their 2200 pounds from 16,000 to 20,000 feet and to land on any ground without capsizing. The actual speed of artillery, photographic, light bombing and protecting planes is from 78 to 93 miles per hour and that of the night planes from 56 to 75 miles per hour.

The maneuvering qualities of a plane are functions of judicious distribution of the different forces to which it is subjected, such as elevating force, weight and forces resulting from the use of the controls. The armament is not the least of the decisive factors of the battle, as it is the one which destroys the power of the enemy.

At the beginning of the war, planes went out armed with carbines or rifles guarding themselves from attack, then little by little, combats became frequent and it was necessary to quickly mount machine guns on chance supports, which it became necessary to perfect rapidly. During the first period of aerial combat but one form of armament was used. The plane, a two-seater, was armed with a machine gun operated by the passenger.

The majority of French planes were of the pusher type and so possessed in the rear a considerable dead angle. The machine gun, generally mounted on a pivot at the front of the body, right or left, made the defense of the plane difficult from the sides.

The German planes, having their propeller in front, yet permitting a rapid shifting of fire to the right or left. The dead angle was thus in front and underneath the pilot's range of vision.

The second period comprises the organization of armament aboard the planes which have been specialized in their accommodation. Three principal formulae were adopted by the French as well as by the Germans:

Shooting forward with a fixed machine gun firing above or thru the propeller (single-seater);

Shooting forward with a fixed machine gun, but with the addition of a machine gun mounted *en barbette* and firing to the rear (two-seater);

Shooting forward and aft with machine guns mounted on independent gun rings (barbettes), and firing under the body with a machine gun on a pivot (three-seater).

The builders have been brought to study the formula of fixed fire to the front thru or above the propeller, at first to allow the monoplanes to become battleplanes, then to avoid the above drawbacks for the machine guns on barbettes or pivots higher up. The main advantage of the fixed machine gun is obviously to permit the pilot of the monoplane to control his machine while using his armament. The machine gun fires in the axis of the plane; the pilot sights his object with his entire plane; the sighting is effected by a sight strictly parallel to the machine gun.

The advantages resulting from this disposition are: All vibrations due to firing are done away with; excellent position of the pilot-gunner; no more deviation produced by the lateral wind or by initial speed of the plane.

The first application of this principle dates from

the appearance of the Nieuport pursuit biplane. The machine gun was mounted on the upper plane and fired over the propeller. The principal disadvantage was the difficulty experienced in reloading the gun.

The second application was shooting thru the propeller, used for the first time by Garros. In order to avoid letting the bullets strike the blades of the propeller, two extremely hard steel guards were fitted on the blades at the point where the bullets passed. This system was abandoned when it was found that it caused the plane a loss of 12 miles per hour. The technical superiority of armament could not compensate in the battleplane for the technical inferiorities caused by the lack of speed.

The third application of the formula was brought out by the Germans at the time of the appearance of their single-seater Fokker battleplane. The machine gun shoots thru the propeller but is regulated by the motor, the bullets passing thru in the intervals between the blades.

Another system of armament exists for slower two-seater planes, assigned to missions of regulating artillery fire, taking photographs, and making small bombardments. Their armament is defensive; a forward machine gun firing thru the propeller, serves in particular for attacking; another machine gun in rear is mounted on a turret. The forward gun corresponds to the type used by the infantry while the after gun is a much lighter weapon.

The third system of armament is the one applied to the three-seater plane, either for protection or bombing. This type of plane is defensively armed. In order to clear the front of the body, the plane is fitted with two motors and two propellers. This series is comparatively recent and has a speed of about 93 miles per hour—a speed equivalent to the planes used for regulating artillery fire, etc. They are used to protect the lines, to protect spotting machines or to execute heavy bombardments. The armament comprises a movable machine gun on the forward turret, a movable machine gun on the rear turret and a movable machine gun on a pivot, the latter firing thru a trap door under the body.

These planes are difficult to attack as they are protected on all sides. The tactics against these fortresses is evidently, to tire the rear gunner who is compelled to pass constantly from his turret to his lower trap door, if the battleplane harasses him by its acrobatics.

The following table gives a general outline of the main features of the German planes now commissioned:

Battle or Pursuit Planes.—One engine of 200 h.p.; single-seater biplanes, 270 sq. ft. surface area; two machine guns firing thru the airscrew.

Artillery, Spotting, Photography, and Short Range Bombing Planes.—One engine of 220-260 h.p.; two-seater, 430 sq. ft. surface area; one machine gun firing thru airscrew, and one mounted on a turret.

Protection and Long Range Bombing Planes.—Two engines, 500-550 h.p.; three-seater, 1080 sq. ft. surface area; one machine gun forward, on a turret; one machine gun aft, on a turret, and one machine gun pivoted underneath the body.

[Armament of Airplanes. News notes. *Memorial de Artilleria,* Mar, '18. 2000 words.]

From the beginning of the war when airplanes were equipped only with rifles and carbines, the armament of these engines of war has been constantly developed.

The first change that was made was from the rifle to the machine gun which, for a long time, was located on an improvised mount.

In the present armament of airplanes, three principles have been adopted by all belligerents.

1. Armament of single seaters must insure fire to the front from a fixed mount, either above or thru the propeller.

2. Armament of two seaters must insure fire to the front as above and fire to the rear from machine gun on universal mount.

3. Armament of three seater must insure fire to front from universal mount, fire to the rear from same mount, and fire under fuselage from machine gun on a pivot mount.

The fixed machine gun has the following advantages: It can be fired without releasing controls; the machine gun is aimed by pointing the airplane at the target; and the vibrations due to firing are reduced to a minimum.

With the fixed mount on the upper wing, the difficulties of loading are greatly increased. This mount was first used on the Nieuport machines. This mount increases also the air resistance.

Fire thru the propellers requires that machine gun and motor be synchronized. This type of fire is most generally used with a fixed mount in preference to the one above mentioned. Ammunition belts carry 800 to 1000 rounds in this case.

The German series of Albatros machines D1, D3, Ago D, Halberstadt D, and Fokker D, are all armed with two machine guns on fixed mounts firing thru the propeller from a 1000-round belt for each gun.

There is another formula for armament of airplanes used in minor bombardments, artillery fire correction, photography. This is the series of German "C" planes—Aviatik, Rumpler, L. V. G., none of them exceeding a velocity of 140 to 160 km. per hour. The armament in this case is defensive and consists of a machine gun mounted to fire thru the propeller and an automatic rifle mounted to fire to the rear.

The armament of three seaters, which are used for bombing or battle purposes, is defensive. It is usually a twin-motored machine arranged so that the forward part of the fuselage (the nacelle) is left free from any obstruction to fire or vision. The velocity of these planes is usually 150 kms. per hour. This is the "G" type, such as the Gotha and Friedrichshafen "G" machines.

These machines carry at least three armored machine guns and are veritable air fortresses. They are very difficult to attack, as the attacker runs into machine gun fire from all directions. The tactics used against these machines consists in maneuvering around them so that the machine gunner will have to keep

AERONAUTICS—Continued

moving back and forth from the rear machine gun to the center one.

—Attack—Protection against

[Defense of Our Important Military Establishments Against Aerial Attacks. By 1st Lieut. Alfredo Portales. *Boletín del Ministerio de Guerra y Marina* (Peru), Mar, '18. 1000 words.]

The author mentions the following places as being of military importance; the Military Academy with its arsenals, the artillery barracks at Tacra and the depots or "Maestranzas" of the army. The railway center southeast of San Bernardo is also mentioned as an important strategic point. The anti-aircraft defenses which are prescribed for these places include emplaced anti-aircraft guns, searchlights, and defense aircraft.

—Bombs and Bomb Dropping

See

BOMBS—AERIAL

[War in the Air. By "Aeronautics." *Army & Navy Gazette*, June 29, '18. 800 words]

A Reuter's message of the 24th, confirmed from German sources the losses of the German third bombing squadron which raided the London area on the night of May 19-20. English data accounted for seven machines of the 28 in this squadron. From this German source it is learned that three more crashed in landing, making a total percentage of losses considerably higher than on our own raids into the Rhine valley. The landing of a large bombing machine is very difficult to a pilot accustomed to another type of airplane and the Germans have lost a great number of pilots attempting to learn.

The night bombing airplane is a large machine with two or more engines. It should do at least 100 miles per hour and be capable of carrying at least 1500 pounds of bombs. Also, it should be capable of rising at least 20,000 feet after dropping it's bombs to have a chance of getting home unobserved in daylight. A German type of night bomber, most fitted for raids against England, has five or six engines with an aggregate of 2000 h.p., carrying 5000 pounds of explosives and eight hours' fuel. By reason of their size and strength, these do not require finish of construction. The pilot also need be nothing but a good pilot and navigator.

Night flying has now been systematized so that the losses in training have been reduced. Night flying is done on a stable machine, rigged in such a manner that it will climb slightly if the control lever is let go and adjusted to fly level with the throttle half shut. Landing is the most difficult part of night flying. The pupil should know the machine and the country by heart before attempting a night landing. He should start a straight glide into the airdrome from a couple of miles away. When about 30 or 40 feet from the ground he will shut off the engine, keeping the control lever as on the descent. He should start flattening out early but gradually.

—Combat

See also

MACHINE GUN—AMMUNITION

[Air Fighting. *Air Service Jour.*, Aug 23, '17. 1600 words. Illustrated.]

Air fighting, tho still largely an individual affair, has advanced much since the days of 1914 and early 1915, when pilots occasionally potted at each other with a revolver or light rifle or carbine—in fact, the well-known machine guns are already proving insufficient; and in messes and other places where pilots do foregather, the possibility of throwing flaming onions, lighted oil, liquid fire, even grappling irons, is more or less seriously discussed according to their probable worth. A man nowadays not only has to be a stunt pilot, but a crack shot, if he wants to be master of his art. For such men the only difference between their air work and their sea work is whereas on a ship both platform and target remain at a constant level with often the platform stationary and target moving, in the air it is not so.

A pair of lives are safer where the pilot can stunt around well than if he flies straight and gives his observer a fair chance in a sporting way. Before firing, unless attacked unawares, one should be very careful to maneuver to the best position because, in a burst, if your first few bullets do not hit, the rest will not either. The first bullets do the damage. Again when attacking or fighting always maneuver to get between the sun and the enemy, and, unless he has already spotted you, do not fire too quickly.

The front or fixed gun, which is so much used nowadays, is usually a Vickers for Allied machines. When making the necessary calculations with a fixed gun one must take into consideratoin two things, namely, the speed of the enemy machine and that of your own. Pilots and observers are often uncertain as to which is the best part of a machine to aim at, but I think it is generally admitted that between the pilot and the petrol tank is the "center" of the machine as regards aiming. If you are traveling dead behind or dead toward a hostile machine, in the same path or at an equal altitude no allowance need be made, but just let fire. (Methods of sighting for shooting at an airplane in different positions with relation to the gunner's own machine follow.)

[The Fundamental Principles of Aerial Combat. *Revista Militar* (Argentina), Sept, '17. 4200 words. Illustrated.]

The aviation service is organized differently in the belligerent states. France has various types of aircraft designed for distinct uses. Some are built for reconnaissance and for regulating artillery fire while others are intended for bombing operations. All are protected in their work by escorts of strongly armed and rapid battleplanes.

The Germans generally employ their airplanes without distinction for the various classes of operations. Only the *Fokkers* and the *Walvets* are designed ex-

clusively for battle.

From the technical point of view the French aviation service is the equal of that of the Germans. The French "aces"—expert flyers who have destroyed ten or more hostile avions—generally use *Nieuport* or *Spad* machines.

Naturally it would not be advisable to indicate the methods used by the French champions but it may be said that their successes are largely due to the ease with which they can execute aerial acrobatics.

A well-known instance is that of the encounter of Lt. Navarre with six enemy airplanes while on reconnaissance duty in rear of the German lines. Three or four airplanes surrounded the Frenchman and one took position above and another below so that escape seemed impossible. With admirable presence of mind Lt. Navarre executed a "loop" and placed himself in rear of the enemy. He then charged the group, destroyed two and put the remainder to flight.

Capt. Boelke, the best German aviator, died Oct 28, 1916, after having placed *hors du combat* his fortieth adversary. The German concept of aerial warfare is different from that of the French. Capt. Boelke, when interviewed by a correspondent of the *World* said: "It is said that the German aviators do not venture in rear of the enemy's lines, but remain in their own territory. With respect to battleplanes this is true, as it is desired to keep the enemy in ignorance of various parts and devices of our *Fokkers,* and furthermore, it is our mission to prevent reconnaissance by the enemy and this can best be accomplished by remaining in waiting where the enemy is forced to go." This point of view is interesting in the sense that if the German is victorious his adversary is either destroyed or captured while if he himself is defeated he falls within his own lines and no secrets in the construction of his vessel are revealed to the enemy.

The French aviators have a nobler concept of aerial battle. They do not hesitate to reconnoiter, for 20 or 30 kilometers in rear of the German front. For many days during the Somme offensive the French aircraft formed a veritable aerial barrier that no German air vessel could penetrate. The German tactics generally are to maneuver in groups or at least in pairs. If a hostile airplane is sighted one machine attacks while the other remains in observation some 200 meters above and the same distance in rear.

Boelke and Immelman were different from the rest of their countrymen in that they charged their adversaries boldly with the idea of destroying them with machine gun fire.

German airplanes usually fly at a great height. Identification of enemy airplanes is one of the many difficult problems that the Allied aviators have to contend with.

—Commercial

[The Future of Commercial Aeronautics. By Lt.-Col. Merwyn O'Gorman, C.B. *Aviation,* Nov 1, '17. 2300 words. Illustrated.]

Commercial aeronautics can be divided into three parts:

(a) The home or internal aspect.
(b) The foreign or international aspect.
(c) The Imperial or Colonial aspect.

It will be found that the profitable use of aircraft is based on speed, and that as speed of transit includes door-to-door movements, if there are, as we see at present, considerable terminal time losses, the longer the distance over which aerial work is conducted the less significant are the "terminal charges" upon our time of transit. Therefore international flying will come up early in our development of aerial transit. If we develop our aircraft making and using properly, we shall be the first to wish that other countries may be equipped with "aerial ways" and aerodromes at big centers of industry, finance or pleasure. No one would dream of rebuilding the British fleet six or eight times per year of war. Yet the air fleet requires at least this. Thus the airplane occupies an exciting position halfway between a battleship and a cartridge. To decide on having an air fleet for war is synonymous with having an aircraft industry in peace competent to produce some eight air fleets per annum when called upon.

The policing of the air, tho eventually a means of using a number of armed aircraft without appreciable alteration, can only at first consume aircraft on a small scale, however carefully such a scheme be laid out for expansion when the trade develops. The bugbear of any production is the uneven distribution in time of the orders received. The intolerable burden of keeping a staff and system to give a large rate of output for a short time and at short notice should, if possible, be put an end to by foresight. The Government will necessarily have certain orders of its own to distribute, and if it be found that, like the automobile trade, the industry is fed up by a "season demand," then the Government orders might, if possible, be distributed at such dates and in such a way as to even up the load curve.

It seems to me that a trading airplane can cross a frontier unseen either at great height or by using clouds or at night. It can drop packages at spots prearranged with confederates, and can, without alighting, either return to its own land or continue upon its thru journey. For customs purposes it would be an anachronism to shoot down a suspected smuggler at sight; we can not board an airplane in flight, nor can we know whether he is carrying sufficient hours' fuel to be capable of out-distancing our policemen; moreover, his chance of giving his pursuer the slip by using the shelter of clouds is considerable. At first at any rate, it may be best to accept air-borne goods untaxed; the class of substances carried will only be those of light weight, or of high value for weight, and of these mostly the ones which derive some advantage from rapid transit.

[Aerial Trans-Atlantic Flights. *Mem. de Ingenieros,* Sept, '18. 1500 words. 1 map.]

The author urges the natural fitness of Spain for the eastern end of a trans-Atlantic aerial line after the close of the present war. He believes that the

AERONAUTICS—Continued

improvements in aeronautics brought about by the war will make this easily possible with a reasonable time after the closing of hostilities. He does not believe that airplanes will be found so suitable for this work as will enormous rigid dirigibles of the super-Zeppelin type.

Great Britain

[Aerial Transport and Travel. By Lieut.-Col. Mervyn O'Gorman, C.B., D.Sc. *Aviation*, Feb 1, '18. 4400 words. Illustrated.]

There is talk to-day of aircraft for transport and travel. It would be grossly unjust to say that such hopes and fancies detract from the energies which these persons expend on their war duties; they rather indicate the intention of winning and of carrying on thereafter the life of a virile community.

The three stages:

A. We are to have an Air Ministry and an Air Force.

B. An air fleet differs from a sea fleet in being much more easily expandable. No one would dream of rebuilding the British High Seas Fleet six or eight times per year of war, but an air fleet in action requires, and will continue to require, at least this.

C. A corollary to this is that we will maintain an aircraft construction organization in peace that shall be competent to produce some six or eight air fleets per annum in war.

To-day war orders continue at full flood to fill up the wastage. If they stop suddenly we shall find within three months that the shop organizations are broken up, that all that remains to us is the husk; we shall realize that we could, by timely measures, have saved much of our expensively purchased experience and organization, and have attained a value far greater than the mere buildings and plant. If aircraft using can be induced to pay, aircraft making will of itself continue. But, in spite of the firmest belief in the value of aerial travel, the mere institution of services takes time. Neither three months, nor six months, nor a year will see a thriving air fleet engaged on its routine duties and issuing its routine orders on which the construction business depends. No one expects a continued unrequited expenditure of from $125,000,000 to $250,000,000 per annum on aerial war material in peace times.

If we look back to the birth of the railway and the steamboat we see that for some years they struggled against public apathy—tho their potentiality for good and for the creation of wealth and trade was almost as great in Watt's time as now. In the case of the road vehicle which we now call a motor car, we had something worse than apathy—we had legislation for the alleged protection of the public, all meant in kindness—which killed the motor car in 1837 and retarded the car of 1892, till France was well ahead of us. The greatest danger that aircraft has to fear, after public apathy, is legislative interference.

The danger of government support lies in the conditions which a self-protective public is liable to impose before the technical possibilities are sufficiently known to form the basis for any sort of legislative interference. The fearful might say that great unknown risk to those on the ground is involved in any program of commercial aeronautics. To-day we may safely say that $250,000,000 worth of aircraft is yearly poured out from this country's factories.

The Allies must, during the war, frame a joint policy as to the tolerance of each other's trade and postal aircraft, and agree to air routes thruout the parts of the world which they control. If we can get four or five willing men round a table to agree to admit aircraft mutually, to register them, to agree to simple rules of the road, and to agree that their respective countries should initiate a few lines of landing-grounds so as to constitute safe routes, the early days of trade flying have little more to ask for from the foreign offices of the world. At the present day it is clear to all that no adequate knowledge exists on which to frame rules with discrimination and without hampering technical development.

It is just possible that regulations might meet with support, as much support as is at present accorded to the 20 mile speed limit of the motor car. Let us rest assured that the amount of civil aircraft will for some years be so much less than the amount of military aircraft now existing, that the total of damage to property and inconvenience to the public, which we know at present to be small, will be much further reduced in proportion to the lesser numbers, the future technical advances, and the less strenuous conditions of maneuvering imposed on peace airplanes. It would be unintelligent to pretend that aircraft making can be developed under a compact between employees and managers which shall guarantee continuity of employment for all the manual workers in exchange for a continuity of labor supply to the other. The difficulty is this—the technical developments of the art, the unforeseeable shortage of material, and the unavoidable changes of method and of materials tend, let us say, at one time to the employment in an aircraft factory of 50 per cent of wood workers and 30 per cent of steel workers, and there is no human authority who can pretend to say that in some brief time these proportions will, or will not, be widely changed.

It is unfortunate that the chief contact which the public of England makes with aeronautics is in relation to accidents and casualties. The achievements appear, it is true, but it is almost impossible to visualize them save perhaps in the case of an occasional flight of unusual distance, such as the recent 3000-mile flight from London to Constantinople, or between London and Turin, and these things appear to be disconnected items giving no impression of the hundreds and thousands of miles of continual flying which is taking place.

Air accidents are divided into groups for the purpose of their study: (1) The absence of landing grounds distributed in easy stages to which a flyer can turn for refuge if his engine should stop; (2) the inexperience of the fliers themselves, since the majority of the experienced have been drawn off to the war. Of the remainder, the most important is what is commonly called "Pilot's error." This does not imply that he is blameworthy. In war, maneuvers which are dangerous

are necessary; to loop the loop is a useful war maneuver which may greatly puzzle an antagonist in the air, since the looped path takes the place of the expected forward movement, and therefore falsifies the aim of the adversary. Another maneuver, known as "spiralling," or "spinning," if contrived to give the impression that the airplane has been thrown out of control, is one of many ruses for breaking off a fight. Under fire and pursuit safety comes from lightness and maneuverability as much as, or more than, it does from strength and solidity; in trade work the conditions are largely changed if not reversed. Aircraft travel and transport, therefore, will, if landing grounds are provided, not be exposed to any of the risks above named, and accordingly from the list of accidents which occur to-day, we must eliminate almost all these in any prognostication as to the future safety of flying.

We have learned that the back firing of an engine can be made innocuous by drawing the air supply of the engine from outside the body work. The use of electrically heated clothes called for by fighting at heights such as 20,000 feet, will not be nominally desirable. The accident if it can be so called, of losing one's way in the fog will be far less likely to result in disaster, when there are more landing-grounds, because we now know that fogs are quite local in their occurrence at any one moment.

Broadly, it may be said that air transport will not develop save by taking a line of footprints given by research. Research of various kinds is remunerative in two different ways: (a) quickly; and (b) eventually.

Patent laws stimulate advancement by providing that there shall be a reward, and that all and sundry shall not be able to possess themselves of the fruits of one man's labor, and thereby dispossess him. I do not think that much is to be gained by suggesting routes at the present moment, unless we propose to permit a few machines to be withdrawn from war service, and then by using a few pilots who are not fit for war service, explore the practical possibilities of such transport. I think it far better to start by carrying mail, rather than passengers.

I am inclined to endorse Mr. Holt Thomas's view that, if we consider the average wind speed as 30 miles an hour, sometimes with us and sometimes agaist, we shall need machines whose own air speed is 120 miles per hour, in the case when there is any competition with other means of transport. In conclusion, it is only half a truth to say, with Frederick List, "The sea is the high street of the earth. The sea is the parade ground of the nations. The sea is the arena for the display of strength and enterprise of all nations."—There is now the air.

—Design of Airplanes

See also

AERONAUTICS — SEAPLANES — DESIGN AND CONSTRUCTION

[Course in Aerodynamics and Airplane Design. By A. Klemin and T. H. Huff, Instructors in Aerodynamics, Mass. Institute of Technology. *Aviation,* July 15, '17. 2460 words. Diagrams.]

Wing structure analysis of biplanes.—There are many difficulties in the analysis of a biplane construction: the distribution of loading between the upper and the lower plane: the resolution of loading in the planes of the lift truss and the internal bracing; the resolution of loading to give bending moments on the spars and the alternative methods which may be employed in drawing up the stress diagrams. The information available regarding the distribution of loads between the upper and lower planes is scanty and contradictory. If x is equal to the gross loading per square foot on the lower wing then $11/9\ x$ is the loading on the upper wing. Unless the biplane truss falls away very much indeed from the conventional truss form this will be a fair approximation. As the angle of incidence of a wing changes, the center of pressure moves, and accordingly varying loads are placed on the rear and front spars. The spar arrangement has to be so fixed that too great a proportion of the load is not thrown on either of the spars within the usual angles of flight. Two distinct methods have been adopted in getting out stress diagrams of the lift truss. (1) The truss is treated as if pin jointed thruout by the ordinary bridge truss method and the bending moments for the spars found as if they were freely supported at the ends with uniformly distributed loads. (2) The spars are treated as if continuous so that the bending moments in them and reactions at their supports are found by theorem of three moments. Then the stress diagrams will be drawn with the reactions as a basis. The first method has the advantage of simplicity and of giving a very large factor of safety. The second method is very much more difficult but probably nearer the mark.

Theorem of three moments.—Forces to the left of a point must tend to turn a beam clockwise about that point in order to give a positive bending moment at the point—anti-clockwise to give a negative bending moment. Forces to the right of a point must turn the beam anti-clockwise about that point in order to give a positive bending moment at the point—clockwise to give a negative bending moment. If these rules are observed the effect of the bending moments is also automatically fixed.

[Course in Aerodynamics and Aeroplane Design. By A. Klemin and T. H. Huff, Instructors in Aeronautics, M.I.T. *Aviation,* Aug 1, '17. 1200 words. Illustrated.]

Reactions in Plane of Lift Truss.—The bending moment diagram for the upper rear spar as a continuous beam has been considered and the appropriate reactions found. The running loads were in the ratio of 14 to 13.8. Hence the reactions are:

R2	83.1 x 14/13.8 equals 84.8 lbs.	For upper rear spar.
Ro	116.5 x 14/13.8 equals 118.0 lbs.	" " " "
R1	34.6 x 14/13.8 equals 35.1 lbs.	" " " "

The ratio of loads on the upper plane to lower plane is 14 to 11.5. The reactions are:

R2	84.8 x 11.5/14.0 equals 70 lbs.	For lower rear spar.
Ro	118 x 11.5/14.0 equals 88 lbs.	" " " "
R1	35.1 x 11.5/14.0 equals 28.8 lbs.	" " " "

From these figures it is possible to draw the stress diagram for the lift truss and the stress diagram for

AERONAUTICS—Continued

the internal bracing of the upper wing at O deg. incidence. (Illustrated in article.) The worst loads occur at O deg. incidence and about 3 feet from the wing hinge. They are compression from the lift diagram of 675 lbs., compression from the drag diagr .n of 330 lbs., and bending moment of 44 lbs. To determine the dimensions of the spar it is first necessary to fix the depth of spar for the R.A.F.6 wing curve employed. The spar is placed at 30 per cent from the rear edge where the thickness of the wing is .054 of the chord. For a 62 in. chord this gives a thickness of 3.34 in. Deducting the thickness of the rib flanges, the effective depth will be reduced to 3.079 in. From this the actual area is drawn and moments of inertia have to be computed together with the factor of safety consequent thereon. The quickest way to determine the moment of inertia is to compute for a solid section and deduct the moment of inertia for the material channeled out. The stress in the outermost fibers will now be given by the formula:

f equals P/A plus My/I, where P equals the direct load y the distance of the outer fibers from the neutral axis, and f equals stress. f equals 1105/2.61 plus 528 x 1.54/2.96 equals 725 lbs. Allowing a maximum fiber stress for spruce of 6500 lbs. we get a factor of safety of 8.9. Since the load on the lower wing will always be considerably less than the upper wing and the spars have the same dimensions no computation need be made. Wood is much weaker in shear than in either tension or compression and spars are made solid for about 3 in. on either side of a supporting member to allow for the maximum shear. The formula for shear is: q equals F/Ib x Ay. This for the section under consideration gives a shear of 13.8 lbs. Allowing a shear value of spruce to be 400 lbs./sq. in. we have a factor of safety of 29.4. (This ends the course which has been running thru 18 numbers.)

[Controls and Control Surfaces. By W. J. Waterhouse. *Aviation*, Sept 1, '17. 3652 words. Illustrated.]

This article covers the details of controls from a structural point of view only. While at first the designers and constructors paid little or no attention to the strength of elevators, rudders, stabilizers and ailerons, with the increase of airplanes in size, speed and horsepower more skill has been displayed in the design of these important parts. The tail surfaces of each type of airplane have some particular characteristics of their own. In this article the air loads on tail surfaces for the two seater reconnaissance type tractor are considered. This machine has the following characteristics: weight 2750 lbs., maximum speed 87 m. per hr., minimum speed 45 m. per hr., horsepower 150-160. With the elevators set at an angle of incidence of 20 deg. and the stabilizers at an angle of -6 deg. the average loading for the above type will be 50 lb. per sq. ft. for the elevators and 22 lbs. per sq. ft. for the stabilizers. In the tests conducted the surfaces were attached to a jig specially designed to support them in the same manner as when fixed to the body. The load was applied to the top surface of the stabilizers only. The elevators sustained a load of sand in small bags of 455 lbs., or 17.5 lbs. per sq. ft., while the stabilizers sustained a load of 2250 lbs., or 55.5 lbs. per sq. ft. When failure occurred the metal fittings gave away; the wood members were still intact. The old and dangerous types of wing hinges made of screw eyes or whang leather have been discontinued and the male and female type of eye bolt, and the cold rolled steel blanked out type substituted in their stead. Considering cost, weight, strength, and production the eye bolt type has everything in its favor. Nearly all elevators have a leading edge made of steel tubing or spruce I beam while the trailing edge is either laminated wood or flattened steel tubing. The wooden trailing edge is preferred as it gives away at the point of stress when the edge strikes an obstacle while the steel tube will tear free from the surface taking part of the structure with it.

The question of warping of wooden trailing edges can easily be overcome by treating the material with the proper kind of moisture proof varnishes. It is obvious that an elevator supported at three points, along its trailing edge, can sustain a greater uniformly distributed load than one supported at but one point. This same reasoning applies to the rudder, stabilizer and ailerons. The practice of placing wireless ailerons, elevators and rudders, on high speed machines of the scout type, has proven successful; but in this case the surfaces are of high aspect ratio, thereby reducing the lever arm length of the air load on the surface to a minimum. In attaching the guy wires leading from the control post to the trailing edge of all control surfaces, great effort should be made to get the strongest combination possible.

In mounting the mast in the desired position on the elevator, care must be taken to anchor the base, in such a manner that the bolts be not over stressed. Since the load on the elevator is transmitted thru guy wires to the top of the mast and at that point balanced by the pull on the control lead, we see that the stress in the mast is mostly compression. During the sand loading test the elevator masts failed long before the structure showed any signs of collapse, due to the fact that the point of attachment for the control lead was so far above the point of guy wire attachment that the part failed by bending. It was necessary to replace the mast with one in which the control lead and elevator brace wires pull from the same point.

The writer recently conducted tests to determine what force, in man pounds, the average pilot could exert directly upon the control levers. The results of the investigation showed that a force of 200 lbs. could be exerted in pushing or pulling upon the control bridge or yoke, 150 lbs. twist or torsion upon the wheel and 200 lbs. upon the foot bar. The average control arrangement allows a ratio of 2 to 1 between the control levers and the tail surfaces, i. e., a force of twice that applied on the lever is imposed upon the tail surfaces. While the Dep. control is very reliable, it is bulky and necessitates a wide body to prevent cramping the pilot. The stick control has proven its worth

abroad. It is much lighter and less complicated and requires less width of body, for the same radius of operation given by the Dep. It also has the advantage of being mounted to the floor thereby relieving the seat rails of considerable stress.

Considering the stresses imposed upon the seat rails, due to the effect of centrifugal force on the body of the pilot in coming out of a loop or steep dive, we find that the stresses may be increased to as much as five or six times that of the normal load. The mounting of seat rails, seats, control levers, and foot bars, deserves every attention, for the dangers of a weak control system are unlimited. In mounting rudder bars, some provision should be made for adjusting same, as the length of pilots' legs vary with their stature.

[Determination of the Moments of Inertia of an Airplane. By John J. Rooney. *Aviation*, Oct 15, '17. 1000 words. Illustrated.]

The sum of the products of the mass of each elementary part of a body by the square of its distance from a given axis is called the moment of inertia of the body about that axis. In the case of the solid, there are always three rectangular axes passing thru any particular point, about each of which it is necessary to know the moment of inertia. It is the moment of inertia of the airplane about each gravity axis that is required in stability computations. The gravity axes of the airplane are usually selected for the position of horizontal flight. The axes are designated as follows: *x-axis*—the longitudinal gravity axis in the plane of symmetry; *y-axis*—the transverse gravity axis; *z-axis*—the vertical gravity axis.

(a) *x-Co-ordinate.*—This co-ordinate, which is measured along the x-axis from the reference point to the center of gravity, is determined by weighing the airplane on two platform scales under its nose and tail, observing the separate weights, measuring the distance between the points of support, and then taking moments about one of the points.

(b) *z-Co-ordinate.*—As the methods of determining the moments of inertia to be described requires the airplane to be suspended from a pivot so that it is free to oscillate as a compound pendulum, the z-coordinate is determined by a method which makes use of the same suspension. The airplane is first suspended with the x-axis horizontal from a point in the z-axis some distance above the top wing, then deflected thru an angle by means of a known weight attached to the tail at a known distance from the z-axis.

Methods of finding moments of inertia about gravity axes:

(a) *About x-axis.*—The airplane is suspended in a suitable frame by means of two cables in its plane of symmetry placed equal distances on each side of the center of gravity. It is essential in making this determination that the airplane oscillate as a rigid body about its axis of suspension and that all secondary vibrations about other axes be eliminated.

(b) *About y-axis.*—The airplane is suspended so as to be free to oscillate in its plane of symmetry. The airplane is now free to oscillate about an axis parallel to its y-axis.

(c) *About z-axis.*—The same suspension as for oscillation about x-axis, with the exception of the auxiliary wires, is used for this determination. This suspension permits the airplane to oscillate freely about its z-axis after it is once set in motion. The following tabulated results were obtained by the methods outlined for an American made, two-place reconnaissance airplane, of 50 ft. span and weighing fully loaded, for six hours' flight, 2900 lbs.:

(a)	About x-axis:	
	Ix	75,250 lb. ft.
	Kx	5.10 ft.
(b)	About y-axis:	
	Iy	63.600 lb. ft.
	Ky	4.70 ft.
(c)	About z-axis:	
	Iz	151,000 lb. ft.
	Kz	7.24 ft.

[The Velocity of the Flier. From German Correspondence. *Schweiz. Monatschrift aller Waffen*, Oct, '17. 2350 words. 3 photos. 2 figs.]

The most important development in aviation during the war has been the increase in velocity. This increase was made necessary by the development of effective anti-aircraft guns. A modern weapon can be turned on a vertical and on a horizontal axis, so that we can consider all trajectories from a gun enclosed within a dome, within which an aircraft may be struck. The danger zone is passed more quickly if either the height or the velocity of the craft is increased. At the beginning of the war the velocity of a plane was about 80 kilometers per hour, whereas modern planes can make about 180 kilometers. Assuming a gun whose highest range was 4000 meters, a plane whose velocity was 80 km./hr. would pass the danger zone in 7 minutes at a height of 2500 meters, and in 4.3 minutes at 3500 meters, while the times, in case of a velocity of 180 km./hr., are reduced to 3 and 2 minutes respectively. The advantage in favor of the swifter plane is increased by another consideration. During the time of travel of the projectile the plane moves forward. If the time of travel is 20 seconds, a plane with 80 km. velocity moves forward 450 meters, while one of 180 km. velocity travels 1000 meters. But in the face of hostile artillery fire the plane seldom moves in a straight line. So the locus of the plane at the end of the flight of the projectile would be a circle of radius 450 meters for 80 km. velocity, and of 1000 meters for 180 km. velocity with the position of the plane at the instant the shot is fired as the center. The improbability of striking the target varies as the areas of the respective circles, that is, as the square of the velocity. Furthermore, velocity is decreased by ascending and increased by volplaning, the variation being about 60 per cent. This consideration also favors the swifter plane. Further, as a general rule the swifter the plane, the higher its maximum altitude. It follows that a swift plane cannot be combated by a single gun.

AERONAUTICS—Continued

The same considerations apply to infantry and machine gun fire, the usual means of combating infantry fliers, who fly under 1000 meters, and usually under 500. In this case the flyer has to reckon on the combined action of a number of weapons. He can avoid being struck by means of great velocity in irregular curves. Further, the lower the flight, the greater the angular distance covered, as seen from the earth, with the same linear velocity. For this reason aiming at swift planes at low altitudes is impossible.

In a combat between planes the advantage lies with the swifter. Velocity is not the only consideration, but nevertheless as a rule mobility in a vertical plane increases with the velocity, tho mobility in a horizontal plane does not.

The swifter the plane, the more valuable for flights in hostile territory, because of the greater chance of success against hostile planes, the shorter time required for a given mission, and the less dependence on continued good weather. Further, the swifter the plane, the less the retarding effect of head winds. The strongest wind in which flights are made is 18 meters per second. Such a head wind reduces the velocity of an 80 km. plane to 14.5 km./hr., and that of a 180 km. plane to 115 km./hr.

The chief aim of the aircraft industry is therefore to increase the speed. The first consideration is to build stronger motors. During the war the German motors have been increased from 80 to 200 h.p. Of even greater importance is their unconditional reliability and their undiminished efficiency in the thinner air strata. Since the stronger motors are generally heavier, larger planes are required. This increases the speed, does not affect the mobility in a vertical plane, but diminishes the facility of maneuver in a horizontal plane. The latter difficulty is obviated by placing the plane surfaces in two tiers. The monoplane has, consequently, disappeared from the front, the biplane taking its place. In addition to improvement in the motors, it has been the task of the aircraft industry to decrease the weight of the craft and the resistance of the air. Diminished weight permits smaller planes and less energy; smaller planes result in less air resistance; the latter permits less energy. The resulting surplus energy of the motor can be applied to increasing the speed. The resistance can be diminished also by so constructing the parts of the plane as to present the minimum of frontal surface. The Rumpler and Roland planes are examples of improvement in this direction.

The different qualities which may be required of an airplane are somewhat conflicting. For example, increase in speed may involve diminished lifting power and mobility. In consequence different types are built for different purposes. The night-flying planes, used for bomb-throwing, sacrifice speed for lifting power in order to carry a great number of bombs, and can safely do so because of the uncertainty of night defenses. Combat planes sacrifice lifting power for speed and mobility. Reconnaissance planes occupy a mean position between the other types.

The foregoing considerations will apply so long as the principal weapon in air fighting is the machine gun.

[The Technical History of the Airplane. By Capt. F. M. Green, A.F.Ae.S. *Aviation*, Feb 1, '18. 4680 words. Illustrated.]

The history and development of mechanical flight may be confined almost entirely to the present century. In the last century some success had been achieved in gliding flight, models had been made and flown, and at least two man-carrying airplanes had actually left the ground, but it was not until the year 1903 that the Wright Bros. earned for themselves the honor of being the first men to fly. We now hear of flights from Turin to London; of airplanes that carry loads that are measured in tons; we know that flying is common at heights of four miles or more, where the air is less than half its usual density. When we hear of these things it seems as unbelievable to us now that until fifteen years ago no one had flown for half a mile carrying just his own weight as it seemed unbelievable to us fifteen years ago that we should ever fly at all. All the skill of the engineer and all the resources of science were called in to solve the problems as they occurred, until in the short space of fourteen years our scientific knowledge of aeronautics compares very favorably with the world-old science of navigation of the sea.

An airplane, as we know it, has its supporting surfaces fixed relative to itself and is driven forward by the reaction of one or more airscrews. At the beginning of flying, the mere fact that an airplane left the ground at all was considered sufficient proof of its excellence. Nowadays a good performance is one of the important essentials of usefulness of an airplane. There are four main factors that govern the performances of an airplane. 1. The wing surface that supports the weight. 2. The total weight supported in flight. 3. The resistance of the airplane to forward motion. 4. The thrust available from the airscrew or airscrews.

Considering the wings, it is necessary to know how to express the value of any particular arrangement of surfaces. The result at which to aim is to obtain the maximum vertical reaction or lift for the minimum horizontal reaction or drag. Another attribute is, however desirable, viz., that the lift per square foot of plane shall be high, so that as little surface as possible need be used for a given minimum speed of flight. The Wright Bros. did not know if they would be able to fly at all. They chose deeply cambered wing sections so that the maximum lift could be obtained at the minimum speed. The lift drag ratio of their planes was probably about 12 to 1. Present-day wing sections enable us to get a lift drag ratio of 17 to 18. This has been done at some sacrifice of maximum lift coefficient, that is to say, for a given minimum speed we need more surface to support a given weight than with a more cambered plane with a worse lift drag ratio.

Planes are generally made nearly rectangular in plan but with the ends more or less rounded. The ratio of span to chord is called aspect ratio and the higher this is made the better will be the lift drag ratio. From practical consideration, the aspect ratio

of an airplane is generally from 5 to 8. The original airplane of the Wright Bros. was a biplane, consisting of two planes separated by about the width of the chord. Shortly after, monoplanes, triplanes and quadruplanes were made and flown. It is fairly certain that the most efficient plane is the monoplane, for these is no possibility of interference of the planes as there is on the multiplane. Structurally, the biplane is very much easier to make than the monoplane and, owing to this, the biplane construction has been almost universally adopted. The total weight that is carried on an airplane is obviously all-important, and it will, therefore, be useful to see what prospects we have of decreasing weight of airplanes of any given type. We will divide the airplane into the following components: 1. Useful load. 2. Motor unit. 3. Fuel, oil, and tanks. 4. Remainder, being airplane parts proper.

For the purpose of general analysis it is assumed that the motors consume the same amount of petrol per b.h.p. per hour, and the figure, 0.7 lb. per h.p. hour, is sufficiently accurate to cover the weight of fuel, oil, tanks, and pipes. Weight on the average is made up as follows:

	Percentage of airplane parts	Percentage of total weight
Wing structure complete	41%	13%
Body complete	41%	13%
Tail plane, elevator, rudder and fin.	6%	2%
Landing gear	12%	4%

If we take 32 per cent as the weight of the airplane proper we have the balance of 68 per cent to divide up among the motor unit and its fuel and the useful load. The weights of the airplane parts have now been fined down to a considerable extent, and, except for the use of newer materials, progress in saving weight is not likely to be very pronounced. The chief particular in which it is probable that weight will be reduced is in the weight per horsepower of the motor. At the present day the complete motor unit—*i.e.*, the motor itself, the airscrew, water and radiator if water cooled, exhaust pipes, and so on—weighs generally from 3 to 4 pounds per horsepower. It is quite conceivable that in the next few years motor units of 1½ pounds per horsepower will be available, and in all possibility with the improvement in material will enable us to make motor units weighing not more than 1 pound per horsepower in the more distant future.

The resistance of the airplane is made up of two factors. The first is the resistance of the main planes. The second item is made up of the resistance of the body, the struts, wires and fittings of the wings, the landing gear, tail plane, rudder, etc. The resistance of the external parts of the airplane has now been fined down to a considerable extent; modern day airplanes do not differ very much in this respect. The various components of the airplane will generally be found to have the following proportional resistances:

Body	62%
Landing gear	16%
Tail plane, fin, rudder, and elevator	7%
Wires, struts, and fittings of the wing structure	15%

Bodies round in section are somewhat lower in resistance than the square bodies, but the difficulties of manufacture generally make their use undesirable. The resistance of the landing gear is considerable and it is difficult to see how this can be very much reduced. It has been suggested by many people that the landing gear could be stowed away inside the body while the airplane is in flight, and no doubt in the future this may be done.

The thrust available from the airscrew varies directly as the horsepower of the motor, directly as the airscrew efficiency and inversely as the forward speed of the airplane. There is not much room for improvement in airscrew efficiency working under the best conditions, as the efficiency is as high as 85 per cent. When climbing, however, the efficiency will frequently drop to less than 65 per cent. The airplane flown by the Wright Bros. had a speed of 30 to 35 miles an hour, and we have in a few years made airplanes that fly four times as fast. Very briefly the resistance of the airplane and the horsepower of the engine each fall off when the density of the air decreases, but with engines as now designed the horsepower falls off faster than the resistance. It is now proposed to consider what speed we are likely to attain in an airplane of the future flying at the height of 10,000 feet. The assumptions we will make are:

(a) That the planes have variable camber.

(b) That the motor unit weighs 2 pounds per horsepower, and will maintain this horsepower at all heights up to 10,000 feet.

(c) That the body is the best possible shape, completely enclosed with no external fittings.

(d) That the landing gear shall be folded inside the body during flight.

(e) That the airscrew efficiency shall be 85 per cent.

(f) That the percentage of useful load carried shall be 15 per cent.

(g) That the duration of the flight shall be two hours.

Assuming that the weight of the structure is as at present, the weight per horsepower of the complete airplane will be 6.4 pounds. We will now turn the percentage weights into pounds by assuming that the useful load is to be 450 pounds, which may be two people and luggage or perhaps one man and mails. The gross weight of the airplane will therefore be 3000 pounds and the horsepower of the motor 430. In order to accommodate the engine and crew we will consider that the biggest cross section of the body is 12 square feet approximately round in section. The resistance of such a body will be about 2 pounds to the square foot at 100 feet a second forward; *i.e.*, 24 pounds in all. The resistance of the rest of the airplane by careful design can be kept down to 16 pounds at 100 feet a second, consequently at that speed the total resistance other than the wings will be 40 pounds. The permissible loading of the airplane will be 15 pounds per square foot, making a total surface of 200 square feet. We will now take a speed of 350 feet a second, or 240

AERONAUTICS—Continued

miles an hour and find the horsepower required at a height of 10,000 feet; *i.e.*, where the density of the air is .74 of the normal. The resistance due to wing drag, will be 3000/15, which is 200 pounds.

As the airplane is flying at 350 feet a second the body drag will be 3.52 times what it was at 100 feet a second, which will be 490 pounds. As, however, the air is 26 per cent less dense, its resistance will be reduced to 364 pounds. The total drag will be the sum of the body drag and the wing drag 564 pounds in all. Taking an airscrew efficiency of 85 per cent on the power required for flying it will be very nearly 430, which is just the power available. On the assumptions we have made it is reasonably certain that a speed of four miles per minute can be obtained, and as motors of less weight per horsepower become available there is no reason why this speed should not be exceeded. In the original Wright airplanes no attempt was made to obtain stability. It has been found that for purposes of fighting an airplane that is extremely controllable is necessary, and it has been also found that if an airplane is made too stable the controls are apt to become too heavy to make the airplane sufficiently sensitive.

It would be quite possible to design an airplane in such a way that whatever a pilot did with the controls he would be unable to upset the equilibrium of the airplane. Such an airplane, however, would be valueless for fighting, and as practically all airplanes nowadays are made for war purposes there must continue to be an element of danger for the unskilled pilot.

Increase in speed and the increase in controllability both tend to increase the stress that will be put on the structure of an airplane in flight. Experiments have been carried out to determine the increased loads that are likely to occur when doing sharply banked turns and loops. It has been found that the load is frequently increased to three or four times the normal.

The first few years in the history of flying have been years of remarkable progress and we are perhaps likely to be self-satisfied. The writer has often been asked if he thinks that flying will ever become an ordinary means of travel. His answer is that he does not think, but that he knows it will become so. A few years more and we shall laugh to think of the airplanes of which we are now so proud, we shall shudder at the risks we ran, and we shall travel with comfort, speed and safety.

[The Modern Airplane. By F. S. Barnwell, Captain, R.F.C. *Air Service Jour.*, June, '18. 9000 words. Sketches.]

Of air-cooled rotary engines, there are the following: 7-cylinder 80 h.p. Gnome, used only in training machines; the 90 h.p. 9-cylinder Le Rhône, used in very small single seater war airplanes; the 100 h.p. 9-cylinder Monosoupape Gnôme and the 110 h.p. Clerget, the 130 h.p. Clerget, and the 110 h.p. Le Rhône, all-cylinder engines.

The gasoline consumption of rotary engines is about .75 pound per b.h.p. hour, and their oil consumption about .14 pound per b.h.p. hour.

There are various Anzanis and others of the stationary radial air-cooled type. The Anzanis are used in some training machines. The radial type should give a light engine but it must also give an engine of large diameter, and therefore probably of high head resistance.

The 70 h.p. Renault, of the stationary air-cooled V-type, is still used on training machines. It is heavy but reliable. All the air-cooled V-engines have the air screw mounted in an extension of the camshaft. The 160 h.p. 6-cylinder Beardmore is a vertical water-cooled type.

There are no models of the inverted vertical or the horizontal opposed types in the service, altho both types possess great advantages from the airplane designer's point of view. These are: very small bulk of engine above air screw shaft to obstruct the view, low carbureter position making for greater ease in employing a gravity petrol feed from the main fuel tanks, and the possibility of using short and simple pipes to carry exhaust gases underneath the body of the airplane.

The Falcon and the Eagle, Rolls-Royce, also the 140 and 200 h.p. Hispano-Suizas and several different powers of Sunbeam-Cootalens belong to the V-type water-cooled engines. The Rolls-Royce, the Sunbeams and the 200 h.p. Hispano, all drive the air screw thru a reduction gear; the 140 Hispano drives the air screw directly on the crankshaft.

The gasoline consumption of the best modern water-cooled engines is about .5 pound per b.h.p. hour, and their oil consumption is about .04 pound per b.h.p. hour.

The weight per b.h.p. is much the same for all types, the air-cooled rotary being slightly the lightest; but the gasoline consumption for the rotary is about 50 per cent higher and the oil consumption about 200 per cent higher than that of the water-cooled engine. It is hardly practicable to run an air-cooled engine at such high compression as a water-cooled, so the power of the air-cooled engine falls off more rapidly at increasing heights than does that of the water-cooled.

For powers of below 150 b.h.p., an air-cooled rotary is usually employed, for powers above this a water-cooled stationary.

A well designed air screw on a fast airplane is a very highly efficient source of thrust; it can transform, under good conditions, over 80 per cent of the b.h.p. of the engine into "thrust horsepower." The efficiency of an air screw is the fractional value—work done by air screw divided by work given to air screw.

The most efficient form of air screw as regards pitch, is one whose pitch is about equal to or slightly greater than, its diameter. For the same blade form a two-bladed air screw is somewhat more efficient than a four-bladed.

When the question arises as to the best air screw for any particular airplane, we must know the b.h.p. given to the airscrew shaft by the engine on full throttle at all rates of revolution between the maximum power revolutions, and a rate of two-thirds of this maximum. As no air screw is equally efficient at all rates of advance per revolution, one and the same screw cannot be the most efficient for high speed and for climb. Generally, large diameter and fine pitch for climbing, smaller diameter and long pitch for high speed.

An air screw is usually employed which has maximum efficiency at some point between climb-speed and high-speed. The faster the airplane advances, the higher does its engine revolution speed become; so that the advance per revolution does not vary so greatly between the climb-speed and high-speed as it would if the revolutions remained constant. The best climbing-speed is generally about 60 per cent. of the high-speed for fast, modern machines, and probably the best all-round air screw is one designed for maximum efficiency at a speed of about 90 per cent of the high speed.

Next, consider the properties of the wings, or aerofoils, whose function is to sustain the weight of the whole machine with the least possible expenditure of energy.

The shape of the section is the most important feature of an aerofoil, the next most important is its aspect ratio, and the next the form of its ends. Rounding off the end of the aerofoil, in plan view, somewhat increases the efficiency, since a turbulent or eddying air flow is set up at a sharp corner and power is wasted in so doing. Altering the aspect ratio has a variety of effects upon the properties of the aerofoil, the higher the aspect ratio the greater will be the maximum lift value per square foot, and the greater maximum lift-drag value.

Nearly all modern airplanes are multiplanes; that is, they have two, three or four aerofoil surfaces more or less superposed. The vertical distance between any two superposed aerofoils is called the gap, while the distance that the leading edge of one of these aerofoils is ahead horizontally of the other is termed the stagger —positive stagger if the upper aerofoil is ahead of the lower, negative stagger if the lower is ahead of the upper.

In a biplane, the lower aerofoil is less efficient than the upper; in a triplane, the lowest aerofoil is of about the same efficiency as that of a biplane, and the center aerofoil is slightly less efficient still; in a quadruplane, the lowest is of about the same efficiency as that of the biplane while the two center aerofoils are both almost as efficient as the center aerofoil of a triplane.

Positive stagger tends to increase the maximum lift slightly, and also the maximum lift-drag ratio. In a positively staggered biplane, the lower aerofoil is working in a slight down draught from the upper aerofoil, which means that its angle of attack is virtually slightly less than that of the upper, and the tendency is to decrease the shift of center of pressure of the total reaction on the system. Positive stagger, therefore tends to allow of a smaller tail plane.

Negative stagger tends to produce the opposite results. Positive stagger tends to increase the stresses in the aerofoil structure, slight negative stagger tends to decrease them. For the same strength, positive stagger tends to increase the weight of the aerofoil structure, slight negative stagger to decrease it.

A biplane or multiplane is held together by compression struts usually of solid spruce, and by tension wires. These are formed of solid steel rods of circular section, of about 60 tons per square inch, ultimate tensile strength; they are swaged to a flat elliptical section for their entire length except a few inches at each end.

The body is generally a tapered box-girder with wooden longitudinals and struts, and steel wire tie rods; it is generally almost totally covered with fabric. It is the member which presents the greatest of the differences which exist between the two principal types of present-day airplanes—the tractor and the pusher.

For the same conditions almost invariably better results are secured from a tractor than from a pusher. Tho the body of the tractor is in the slip stream from the air screw, and that of the pusher is not, the body drag is nearly always lower in the tractor type. The view forward, upward and downward is generally better in the pusher than in the tractor, for a single-seater machine.

To fire straight ahead, the gun on a tractor must be fitted with an interrupter gear, and it must be fixed, as it is impracticable to swing it about when connected to the interrupter gear. The gear itself weighs from 5 to 20 pounds, and is an additional complication. The gear is usually made up of a cam on the air screw, but working a tappet which by means of sundry bell cranks and pull or push rods operates the trigger of the machine gun. Some form of toggle, or trip-device, is incorporated, and is worked by a Bowden lever attached to the pilot's control lever, so that the gear is normally thrown out of action until the pilot presses this lever. The pusher is as bad for firing astern as the tractor for firing ahead.

The body must be deep enough to afford ample protection to the pilot and gunner; a depth of 36 inches is about the minimum. It must be wide enough to allow ample room to work the guns, and here 30 inches is about the minimum. It is an item of large cross-sectional area and is the part of an airplane which calls for the greatest number of conflicting requirements. It must be large enough to contain the pilot, gunner, tanks, ammunition, instruments, etc., yet the wider it is the worse the view.

The bodies of most modern machines are of a rectangular cross-section, as this is the lightest shape for strength and is simplest to make. With a rotary engined tractor, of which the nose is necessarily a circular section covering, or cowl, round the engine, it pays to continue this circular section well along the body.

The landing gear may be considered in two parts, the main under carriage is almost invariably two-wheeled. These wheels must be far enough apart and far enough ahead of the center of gravity of the airplane to prevent its pitching. The distance apart is seldom less than four or more than six feet, and the best distance for them ahead of the center of gravity lies between eight and fourteen inches.

The axle is sometimes a plain continuous tube, sometimes it is of the divided type. The latter allows of a lighter axle, as the bending moment falls from a maximum at the shock absorber to zero at the hinged inner end, so that the axle tubes may be tapered in strength and therefore in weight.

The tail skid forms the third point of support for the airplane on the ground. Tail skids are divided into two

AERONAUTICS—Continued

classes, steerable and non-steerable.

In practically all modern airplanes the control organs consist of ailerons, or wing flaps, for lateral control, fixed fin for directional stability, rudder for directional control, tail plane for longitudinal stability, elevator flap (or flaps) for longitudinal control.

If the tail plane is large enough for stability, it tends to maintain the machine at one particular attitude to its flight path, which means one particular speed for level flight. If the thrust necessary to maintain the speed be increased, the result will be to make the machine climb, but it will not increase the speed. If the thrust be decreased, the machine will take up a downward flight path.

In modern machines, lateral control is attained almost universally by double-acting ailerons, or wing flaps. This method is more efficient at large angles of attack than warping the aerofoils. At small angles of attack, however, warping is quite as efficient, and a wing without flaps is slightly lighter and more efficient than one with them. The main reasons for the preference for wing flaps is that this method of lateral control is lighter work for the pilot, and permits of a completely braced and safer aerofoil structure.

Considering the airplane as a whole, the points required in modern war machines are: great climbing power, great speed especially at great heights, good view in every direction, any blind spot being a source of danger; extreme ease and quickness in maneuvering; greatest possible field of fire, and slow landing speed.

To attain climb and speed, the weight must be kept as low as possible consistent with the minimum safe strength, and the drag must be kept as low as possible by making every exposed part as small as possible and of the best possible shape. Field of view is a matter of disposition of occupants, of aerofoils and of body shape.

Maneuverability calls for small moment of inertia, small stability, for large controlling surfaces, great strength and light loading. Field of fire is more difficult to obtain than field of view. Slow landing calls for light loading, lighter than is consistent with speed.

[Military Aviation. By A. U. E. *Mem. de Ingenieros*, July '18. 3600 words.]

At the beginning of the present war Germany believed herself to be "Queen of the Air" on account of her Zeppelins, but later developments have shown that the heavier than air machines, or airplanes, now occupy first place in aerial work. It is very true, however, that captive balloons and dirigibles have their definitely outlined spheres of activity, within which the airplanes will not displace them.

The airplane, so far as its construction is concerned, may be divided into two parts; the framework, which is practically perfected at the present time, and the motor, which is still undergoing development and improvement.

An airplane for war work must have a strong, sturdy framework which is not deteriorated by bad climatic conditions but there is a definite limit to the weight which it may have. At present this is considered to be not more than 4.5 kilograms per horsepower of the engine. The entire framework must be carefully designed for the motor which it is to carry, for a change in the power of the motor will entirely disrupt the working balance of the plane. It must also be borne in mind that the spread of wing must be proportional to the weight of the plane, or it will not be possible to fly at high altitudes.

Before the present war it was not thought that the question of weight was of so much importance as at present. The motors might be divided into two classes, the fixed and the rotary, the chief importance being attached to the speed. The rotary motor of 80 h.p. would not exceed 1.5 kilograms per h.p., and required no elaborate cooling devices nor any radiator, but with very long use would heat badly and develop powerful knocks. The most practical of these types have been the Gnome, the Rhone, and the Clerget. The fixed types weighed more but would run for a longer time without heating. In the last four years these have been improved very much as regards the weight per horsepower by means of better proportions and as a result of very much the same type of development which the automobile engine had passed thru ahead of this motor. The best German motors of this type are the Benz and the Mercédès of 6 or more cylinders, vertical type. The French have developed engines of 8 to 12 cylinders arranged in V. Some of the larger airplanes carry four motors developing a total of 1000 to 1200 h.p.

Recent developments of this type of motor have reduced its weight to 1.35 kilograms per horsepower, which is a necessity if we are to reach heights of 6000 meters and speeds of 200 kilometers per hour, with ability to climb very rapidly to great heights and to answer easily to handling by the aviator.

It is essential that a motor should have absolute certainty and positiveness of performance, over great periods of time, with good mechanical equilibrium and uniformity of speed, altho the speed of the airplane is bound to vary greatly between sea level and its upper limits of flight. It is necessary in the design of the motors to make allowance for the great differences in air pressure and temperature at different levels, as the air is very much lighter and colder at the higher levels.

Airplanes are divided by allied writers into four classes, general observation, observing artillery fire, bombing, and chase or combat planes. The Germans use three groups for their classification: 1. photography, observation, and light bombing; 2. heavy bombing; 3. the chase. It is believed that these names are self-explanatory.

—History

See also

LANGLEY FLYING MACHINE

—Instruction and Training

[Practical Hints on Flying. *Air Service Jour.*, Jan, '18. 2000 words.]

Start off full power pointing directly into wind, watch direction carefully and counteract with right rudder the machine's tendency to turn to the left

due to propeller's air blast striking the left side of fin more forcibly than the right side. After attaining a little headway, raise the tail and keep it in this position to prevent machine from leaving the ground until well past minimum flying speed, if possible keep on the ground until maximum ground speed is attained. Then very easily and smoothly take it off the ground.

When once under way attain a safe altitude as soon as possible. It will be found that the best results can be attained by a high speed, low angle climb rather than a slow speed, large angle. After a height of not less than 800 feet, a turn can be contemplated. A higher altitude is better but do not attempt one lower unless necessity demands. If still on the climb and a rather short turn is necessary, nose the machine over until flying level so as to keep the speed high, bring to play the rudder and ailerons in correct proportions and in proper directions to give a smooth, even turn. At no time let the machine attain a high angle of climb, for this encourages it to stall, which would necessitate considerable altitude to recover from safely.

Altho at all times the machine can attain the same speed thru the air, its relation with the ground changes with the wind, so in gliding into a wind you cannot glide as far over the ground from a given height as you can if the same wind were behind also. Flying in a side wind, in order to keep a straight course over the ground, the machine must be swung around into the wind with an angle depending on the velocity of the wind.

When within correct distance for a glide to a contemplated landing place, shut off the engine and nose machine over to the proper gliding angle and head for the field in a direction to bring you directly into the wind. If too close to field and machine is developing excessive speed, start "S-ing" to reduce speed as well as altitude. If there is considerable altitude to spare an easy spiral may be executed.

Never glide too flat, for speed falls off rapidly and the machine settles instead of gliding down. When about fifty feet from the ground, start leveling off, but gradually allow the machine to glide down within about six feet of the ground where the final leveling off begins. At this point the machine is skimming along until its velocity wanes, then as it sinks increase the wing's angle to the air so as to bring the lift again up to the weight of the machine for its loss in speed. As the speed lessens the angle should increase more rapidly until the machine is flying in a correct position for landing at its minimum flying speed.

[Tricks Necessary in Air Fighting. By Lieut. Granville A. Pollock, U.S.A., S.S.C. *Flying*, Apr, '18. 2350 words. Illustrated.]

As a chain is no stronger than its weakest link, so the work of aviation can only be measured by the skill of its pilots. The schooling of a French Chasse pilot receives the first consideration and no effort has been spared to give him every opportunity for instruction and schooling, that he should at least equal the best the enemy could hope to put out. To this end the preference in selection of pupils from other branches of the service, to be trained as *Chasse pilots*, is usually restricted to those who have displayed ability and courage in their own arm of service and have at least obtained either promotion from the ranks or a decoration of some sort, tho the other branches of aviation are not so exacting. After qualifying for his military brevet in the usual way he is sent to the Nieuport school, where he is gradually put thru the various models of this make, starting with the machine of 28 meter surface dual control, and when considered to have mastered this, is given this same type to fly alone. As a rule, a minimum of 15 landings is called for before one passes to the smaller machine of only 18 meters surface. The last tests in this class consist of making two landings in a two seater, with a large sack of sand in the rear compartment, equivalent to a machine gunner, the added weight being a severe test of a pilot's skill. This passed, the next is an altitude of 3000 meters for a minimum of 15 minutes, a sealed barograph being hung on the machine, the record of which is attached to the student's school record.

Pilots are then sent to the famous school at Pau in the South of France for combat training. Here one is given a few try-outs on an 18-meter Nieuport. This passed, one goes to the 15-meter class, a smaller and harder machine to fly and land, for here the speed is about 160 kilometers an hour, and on this one is first taught group flying, and the ways of squadron formation. This passed, one goes to the school of acrobacy. Here all the work is done on the 13-meter "Baby" Nieuport, equipped with 80 h.p. Le Rhone motors, every machine being in the finest condition, all wires, fastenings, etc., being thoroly inspected after every flight, for no chances are taken, as a pupil reaching this stage of instruction represents a very heavy investment. Only one "stunt" at a time is explained, which is repeated by the student, and unless every movement is understood thoroly he is not permitted to attempt the work.

To start the famous "vrille" the pilot ascends to a height of not less than 800 meters, as shown on his altimeter, and then after a minute or so flying level, switches off his motor, the same instant pulling the control stick quickly back towards him and at the same time towards the side, accompanying it by a sudden push of the foot, right or left, depending to which side the control stick was directed. The result is that the machine shoots suddenly up losing speed—in fact, stalling—and falls sharply over to the side, with a twisting or cork-screw movement, which is varied by the sharpness with which the rudder pressure has been utilized. In every case the twists should begin sharply, and every pilot is instructed to at once replace his controls in the center, feet straight, and to slowly push the control stick forward a few inches. The machine then ceases its whirl, points forward, and dives straight down. The pilot at once redresses his control so as to bring his machine on an even keel, and switching on his motor again, flies off in a straight line. The object of all acrobacy is to produce, whenever possible, all adverse conditions of flight that a pilot may ever be expected to encounter, and to teach him how to meet them.

AERONAUTICS—Continued

classes, steerable and non-steerable.

In practically all modern airplanes the control organs consist of ailerons, or wing flaps, for lateral control, fixed fin for directional stability, rudder for directional control, tail plane for longitudinal stability, elevator flap (or flaps) for longitudinal control.

If the tail plane is large enough for stability, it tends to maintain the machine at one particular attitude to its flight path, which means one particular speed for level flight. If the thrust necessary to maintain the speed be increased, the result will be to make the machine climb, but it will not increase the speed. If the thrust be decreased, the machine will take up a downward flight path.

In modern machines, lateral control is attained almost universally by double-acting ailerons, or wing flaps. This method is more efficient at large angles of attack than warping the aerofoils. At small angles of attack, however, warping is quite as efficient, and a wing without flaps is slightly lighter and more efficient than one with them. The main reasons for the preference for wing flaps is that this method of lateral control is lighter work for the pilot, and permits of a completely braced and safer aerofoil structure.

Considering the airplane as a whole, the points required in modern war machines are: great climbing power, great speed especially at great heights, good view in every direction, any blind spot being a source of danger; extreme ease and quickness in maneuvering; greatest possible field of fire, and slow landing speed.

To attain climb and speed, the weight must be kept as low as possible consistent with the minimum safe strength, and the drag must be kept as low as possible by making every exposed part as small as possible and of the best possible shape. Field of view is a matter of disposition of occupants, of aerofoils and of body shape.

Maneuverability calls for small moment of inertia, small stability, for large controlling surfaces, great strength and light loading. Field of fire is more difficult to obtain than field of view. Slow landing calls for light loading, lighter than is consistent with speed.

[Military Aviation. By A. U. E. *Mem. de Ingenieros,* July '18. 3600 words.]

At the beginning of the present war Germany believed herself to be "Queen of the Air" on account of her Zeppelins, but later developments have shown that the heavier than air machines, or airplanes, now occupy first place in aerial work. It is very true, however, that captive balloons and dirigibles have their definitely outlined spheres of activity, within which the airplanes will not displace them.

The airplane, so far as its construction is concerned, may be divided into two parts; the framework, which is practically perfected at the present time, and the motor, which is still undergoing development and improvement.

An airplane for war work must have a strong, sturdy framework which is not deteriorated by bad climatic conditions but there is a definite limit to the weight which it may have. At present this is considered to be not more than 4.5 kilograms per horsepower of the engine. The entire framework must be carefully designed for the motor which it is to carry, for a change in the power of the motor will entirely disrupt the working balance of the plane. It must also be borne in mind that the spread of wing must be proportional to the weight of the plane, or it will not be possible to fly at high altitudes.

Before the present war it was not thought that the question of weight was of so much importance as at present. The motors might be divided into two classes, the fixed and the rotary, the chief importance being attached to the speed. The rotary motor of 80 h.p. would not exceed 1.5 kilograms per h.p., and required no elaborate cooling devices nor any radiator, but with very long use would heat badly and develop powerful knocks. The most practical of these types have been the Gnome, the Rhone, and the Clerget. The fixed types weighed more but would run for a longer time without heating. In the last four years these have been improved very much as regards the weight per horsepower by means of better proportions and as a result of very much the same type of development which the automobile engine had passed thru ahead of this motor. The best German motors of this type are the Benz and the Mercédès of 6 or more cylinders, vertical type. The French have developed engines of 8 to 12 cylinders arranged in V. Some of the larger airplanes carry four motors developing a total of 1000 to 1200 h.p.

Recent developments of this type of motor have reduced its weight to 1.35 kilograms per horsepower, which is a necessity if we are to reach heights of 6000 meters and speeds of 200 kilometers per hour, with ability to climb very rapidly to great heights and to answer easily to handling by the aviator.

It is essential that a motor should have absolute certainty and positiveness of performance, over great periods of time, with good mechanical equilibrium and uniformity of speed, altho the speed of the airplane is bound to vary greatly between sea level and its upper limits of flight. It is necessary in the design of the motors to make allowance for the great differences in air pressure and temperature at different levels, as the air is very much lighter and colder at the higher levels.

Airplanes are divided by allied writers into four classes, general observation, observing artillery fire, bombing, and chase or combat planes. The Germans use three groups for their classification: 1. photography, observation, and light bombing; 2. heavy bombing; 3. the chase. It is believed that these names are self-explanatory.

—History

See also

LANGLEY FLYING MACHINE

—Instruction and Training

[Practical Hints on Flying. *Air Service Jour.,* Jan, '18. 2000 words.]

Start off full power pointing dire[illegible] watch direction carefully and count[illegible] rudder the machine's tendency to [illegible]

due to propeller's air blast striking the left side of fin more forcibly than the right side. After attaining a little headway, raise the tail and keep it in this position to prevent machine from leaving the ground until well past minimum flying speed, if possible keep on the ground until maximum ground speed is attained. Then very easily and smoothly take it off the ground.

When once under way attain a safe altitude as soon as possible. It will be found that the best results can be attained by a high speed, low angle climb rather than a slow speed, large angle. After a height of not less than 800 feet, a turn can be contemplated. A higher altitude is better but do not attempt one lower unless necessity demands. If still on the climb and a rather short turn is necessary nose the machine over until flying level so as to keep the speed high, bring to play the rudder and ailerons in correct proportions and in proper directions to give a smooth, even turn. At no time let the machine attain a high angle of climb, for this encourages it to stall, which would necessitate considerable altitude to recover from safely.

Altho at all times the machine can attain the same speed thru the air, its relation with the ground changes with the wind, so in gliding into a wind you cannot glide as far over the ground from a given height as you can if the same wind were behind also. Flying in a side wind, in order to keep a straight course over the ground, the machine must be swung around into the wind with an angle depending on the [illegible] of the wind.

When within correct distance for a glide [illegible] contemplated landing place, shut off the engine and nose machine over to the proper gliding angle and head for the field in a direction to bring you [illegible] into the wind. If too close to field and [illegible] developing excessive speed, start "S-ing" [illegible] speed as well as altitude. If there is [illegible] altitude to spare an easy spiral may be [illegible].

Never glide too flat, for speed falls off [illegible] the machine settles instead of gliding down. [illegible] fifty feet from the ground, start leveling [illegible] ually allow the machine to glide down [illegible] six feet of the ground where the final [illegible] gins. At this point the machine is [illegible] until its velocity wanes, then as it [illegible] wing's angle to the air so as to bring [illegible] up to the weight of the machine [illegible] As the speed lessens the angle should [illegible] rapidly until the machine is flying [illegible] tion for landing at its minimum [illegible]

[Tricks Necessary in Air Fighting [illegible] ville A. Pollock, U.S.A., S.S.C. [illegible] words. Illustrated.]

As a chain is no stro[illegible] the work of aviation [illegible] of its pilots. The s[illegible] receives the first con[illegible] spared to give him [illegible] and schooling, that h[illegible] the enemy could hope to [illegible]

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AERONAUTICS—Continued

Following the "vrille" the next is a "renversement," or change of direction without loss of height and without reducing speed. This is also performed to either side with uniform results, but unlike the "vrille" the ailerons are not used. "Changement de direction" means to turn as quickly as possible in the opposite direction, without either loss of speed or height. It is very seldom used, but a valuable trick to know. The result is startling at first, for the pilot will feel as tho he were being forced thru the seat, so strong is the centrifugal force acting, yet in reality he makes a comparatively wide bend, not unlike a hairpin. This also is done to the right or left, and is usually done three or four times. "Retournment" is performed very similarly to a "renversement," but instead of coming out in an opposite direction the movement is continued until one is again on the original course. This is difficult to perform at first, and therefore is seldom attempted by a pilot until after he has had some experience at the front. To commence, one does as in a "renversement," pulling the control back, the machine mounting sharply; a kick of the rudder and the tail goes up as the machine starts to fall to one side. But now as the position approaches the vertical, the foot is only partly recovered, while the control is pulled moderately to the same side, as used by the rudder. This produces a half spin, sufficient to bring the machine back to the former direction. It is important that the aileron should be used here, for if rudder alone is used the movement will be too slow to be of value in a fight, and result in considerable loss of height.

Last and by far the most difficult to execute, is the horizontal "vrille" or barrel roll, which is very spectacular, but the use of which in combat is questionable. This is usually started by slightly reducing the speed of the motor, pulling the control stick well towards the pilot, and giving a very quick push to the rudder—to the full extent in fact—and at once replacing all controls in the center. The machine starts to mount suddenly, but the full effect of the rudder swings the machine up on one wing, over completely sideways, which follows with a wing slip and a flattening out sideways. The whole presents a most striking effect, and unless the pilot is quick, will follow with a loss of speed and a vrille. Looping is not done or encouraged, as it is of slight value in a fight, because when a machine is inverted the pilot is helpless for a moment, until his machine has passed the dead point and started downward, and the enemy who is following him has a good target. The so-called "tail slide" is as a rule a stall. As a matter of fact, a proper tail slide cannot be done with any machine using ailerons, for when done properly the reversal of pressure will cause them to buckle.

A "tail slide" is never attempted by even the most experienced pilot unless his machine is fitted with warping wings, and even here there are only one or two monoplanes that are built sufficiently strongly to stand the reversal of pressure; the "looping" or exhibition Morane-Saulnier being the best known. It was on this make of plane that Gustave Hamel so frequently thrilled audiences before the war.

[Tests That Aviator Candidates Must Take. *Air Service Journal,* Apr 8, '18. 650 words. Illustrated.]

There are a number of essential tests which candidates for service as aviators must undergo and some of the tests are likely to cause the men considerable surprise. His own common sense should indicate to the man whether he possesses the normal qualifications for service in the air. He must have qualities of mind as well as qualities of physique; neither without the other will help him. In other words a mental and physical balance is what most is sought. Tests of the chest, nose, throat, blood pressure, sense of vision and of balance are made with scrupulous thoroness and care. In these matters the applicant must pass to the complete satisfaction of his physician examiner. To the layman these tests, while interesting, are somewhat bewildering. Probably those who undergo them experience difficulty in understanding exactly what they are all about—but they disclose what the examining physician wishes to ascertain concerning the man under examination. The ear-balance sense is tested by the rotation of the candidate with the head tilted at various angles. The response to the stimulation of rotation is manifested by nystagmus (oscillation of the eye-ball), past pointing and falling in a definite direction. The past pointing test comes next. Following rotation to the right the candidate extends his arm with the index finger in position for pointing. He is directed to touch the finger of the examiner, then to raise the arm and to immediately bring it down to touch a second time. While the stimulation resulting from the rotation persists the normal individual cannot touch the finger of the examiner the second time, but points past it to the right. The static and dynamic test consists of blindfolding the candidate and requiring him to stand at attention for one full minute without swaying. He then marches forward twenty feet to a halt, and backward to the starting point without deviation from a straight line. The binocular single vision test is made with a stereoscope. After the apparatus is properly focused the candidate must perceive instantly and accurately the relative distances from the eyes of objects situated at different depths in the picture. Obviously one who is unable to judge correctly whether one object is nearer than another has no place in an airplane.

Great Britain

[The Teaching of Flying. *Air Service Jour.,* Dec, '17. 8000 words.]

(This article outlines the course given to a civilian who joins the Royal Flying Corps.)

The candidate goes to the Cadet's School and takes a course in purely military subjects, including a grounding of drill, discipline, care of arms, interior economy, military law and the use of the machine gun. Upon completion of this course, which lasts two months, the cadet is sent to the Flying Corps Training School for technical training on the ground.

At the Flying Corps Training School the cadet is taught the theory of flight, wireless signaling and receiving, care of machine guns, operation of the camera,

map reading and observation of artillery fire with models. Upon successful completion of this two months' course he is commissioned on the General List and joins a preliminary training squadron. The cadet starts on the Maurice Farman and, after having reached a certain standard of efficiency and completed a certain number of hours in the air, he is sent to an advanced Training Squadron, or Service Squadron, where he is taught to fly Service types of machines and eventually qualifies for his wings. He is then gazetted as a Flying Officer of the R. F. C. and sent to a Service Squadron.

In order to qualify as an expert pilot he has to fly at the greatest height his machine will make, dive and loop and side-slip to enable him to be an efficient fighter. He must have had considerable experience in photography from the air, as well as in the observation of artillery fire, the transmission of wireless messages and the use of the machine gun. In addition, he must be an expert bomb dropper, have experience in bombing raids, long reconnaissance and in fighting patrols.

The first portion of technical training is the care of engines, rigging of airplanes, the use of the compass, the use of instruments and other details. This is carried out at the two schools of military aeronautics; engines are taken down and erected, samples of as many types as possible being used. The technical training in the air includes instruction in flying pure and simple without any direct reference to its military uses.

Many military qualifications are demanded from the modern pilot. At the school of military aeronautics, the pupil gets a good grounding in the elements of his specialty. This training he completes from practical experience when he gets on flying instructions. During this preliminary training in flying, his military training is still theoretical and on the ground, but in the advanced training squadrons he begins to fly in formations and to drop bombs at targets. He practices artillery observation by means of powder puffs on the ground and is sent across country to photograph various places. Fighting in the air is also practiced by various methods. Two machines may be sent up to maneuver against one another, both trying to attack, or the pupil is sent up while the instructor tries to attack him, or vice versa, or the instructor goes out and attacks a group of his pupils returning from a cross country flight.

United States

[Technical Courses for the Air Service. *Air Service Jour.*, Mar, '18. 2800 words.]

The War Department, thru the Federal Board for Vocational Training, is making a drive to secure an adequate quota to meet the requirements of the air service.

The plan is to be carried out thru the several State and vocational schools, co-operating with the Federal Board. It contemplates the preparation of men, so far as possible, before they go to the cantonments.

The instruction will include courses to fit men as cabinet makers and carpenters, coppersmiths and sheet metal workers, engine repair men, ignition repair men, instrument repair men and motor car and truck chauffeurs.

Following is a tentative outline of these courses:

Cabinet Makers and Carpenters.—Woods used in airplanes, joints, splicing, glue, fastening (without and with glue), repairing and reglueing, models and field sketching.

Coppersmiths and Sheet Metal Workers.—Tools and appliances used, precautions against explosion, sheet metal work, brazing, machine work, hand punch work, hand shear work and fastening.

Engine Repair Men.—General principles of four cycle engines, types, multi-cylinder engines, ignition system, taking down motor, bearings, valves, ignition, starting and lighting system, starting motor, fuse block, ammeter, lights, carburetor, cooling system, oiling system, oil pumps, reassembly of motor and testing.

Ignition Repair Men.—Electricity, ignition, magnetos, battery system, distribution, distribution of high tension current and Ford ignition.

Instrument Repair Men.—Aneroid barometer, tachometer, oil pressure gauges, voltmeter and ammeters, testing for burned out coils, locating grounds, calibrating or correcting instrument, replacing compasses, and expansion chamber.

Motor Car and Truck Chauffeurs.—Front axles and steering gears; rear axles including adjustment of wheels, radius rods, chairs, differentials, brakes, and thrust rods; transmissions and clutches; engines, including valve guiding and adjusting, bearing adjusting, locating trouble and operation and testing of engines in general; lubrication of engine, clutch, universal and all parts requiring lubrication; ignition; carburetion; driving.

The men enrolled for these courses are to be selected according to their previous occupations in order that they may make use of their former training and experience.

—Instruction and Training—Schools

[Princeton's School of Military Aeronautics. *Air Service Jour.*, Apr, '18. 3500 words.]

First the cadets are given a talk by the head of the Military Department. They are instructed in the simple directions for marching in order that they may march to classes in proper formation. Then follows a lecture by the President of the University. At the conclusion of this lecture, the commander of the Aviation School takes the cadet in hand. He explains the customs of the service and talks on military etiquette and its importance. A reading of the Articles of War follows.

At this point each cadet undergoes a thoro physical examination by the doctors. Here he starts in his routine for the first week. This work consists principally of military drills in the School of the Squad and School of a Squadron, officers acting as instructors. During this week the cadet receives about twenty-five hours of practical and six hours of theoretical military instruction. The cadet also receives preliminary

AERONAUTICS—Continued

lectures on a few technical subjects, such as signal and radio work and airplanes.

The remainder of the cadet's course at the Ground School comprises study of: Signaling and Radio, Airplanes, Meteorology, Gasoline Engines, Types of Motors, Aerial Tactics including co-operation with infantry and artillery, Machine Gunnery, Airplane Rigging, Map Reading, Airplane Motors, Care and Repair of Motors, including magnetos, carburetors, etc., Spotting, and Bombing.

The cadet is required to satisfactorily complete each course by passing a final examination therein.

Thru the use of a very realistic miniature range, which represents a section of the country on the French front, and on which by means of electric lights, are represented batteries firing and shells exploding; targets, such as hostile batteries, trenches, ammunition dumps, troop concentrations, etc., he secures a definite knowledge of how the ground will appear from an airplane and learns what his many duties as an aviator will entail.

The students are organized into a regiment and cadets act in the capacity of commissioned and non-commissioned officers. This gives them an opportunity to learn to command troops and to understand the duties and responsibilities resting upon the various positions in the army organization. In addition there is a course in trap shooting for the purpose of training the eye and effecting the physical co-ordination of a man for the purpose of aiming.

A class enters and graduates every Saturday. The course requires from three to four months. In case a man fails in any of his work he is always given an additional opportunity to make it up, but he may be discharged at any time that his academic work or his military conduct is unsatisfactory.

Cadets are enlisted in the Signal Enlisted Reserve Corps. They receive $30 a month with uniform and quarters provided by the government and a food allowance of sixty cents a day. Besides the Princeton school there are seven others located at large engineering universities. From these schools the cadets go to one of the new flying schools where they receive instruction in actual flying.

—Instrumental Equipment for

[The Goerz Airplane Glass. *Memorial de Artilleria,* Oct, '17. 1200 words. 6 figures.]

(Description and use of the new Goerz glass for bomb throwing and aerial reconnaissance with a general discussion on bomb dropping, forces affecting the trajectory of a falling bomb, and the calculation of these forces.)

[The Delicate Navigating Instruments Used by Aviators, etc. *Official Bulletin,* May 7, '18. 1800 words.]

Among the problems in production of equipment for aviation purposes that had to be solved by the Signal Corps was that of navigating instruments for the airplanes. There are ten instruments essential for a single seater, and some of these must be duplicated in two- and three-seater planes, so that in the latter case a maximum of 23 instruments is required. A single set of nine instruments costs about $350. These instruments are purchased by the Signal Corps and distributed to manufacturers. Some are adaptations of foreign instruments and others are our own types.

The essential instruments are the tachometer or revolution counter, the air speed indicator, the altimeter (aneroid barometer), the airplane compass, the airplane clock, the gasoline pressure gauge, the oil pressure gauge, the radiator thermometer, the banking indicator, and the Aldis sight, the latter used for fixed guns firing thru the propeller.

—Instrumental Equipment for—Mirrors

[Aeroplane Mirrors to Prevent Accidents. By an Aeroplane Pilot. *Flying,* Mar, '18. 1080 words.]

It is the practice in Europe to use mirrors in front of single-seater machines, so that the aviator can see an opponent approaching from behind. Such a mirror has also been tried in this country and found very convenient in ordinary flying. First, in watching all parts of the machine behind the aviator. Second, in watching for the approach of any other machine, and thus diminishing danger of collision and last, but not least, in watching the passenger or pupil seated behind the aviator. Nearly all the machines in use in Europe are so built that the pilot has an unobstructed view overhead. This is usually accomplished by cutting away the airfoil above the pilot's head, but by sometimes having the cockpit in which the pilot sits either wholly in front of the wings or wholly back of them. Much danger would be averted were this rule more universal in this country, where the reverse is common.

Now, if a pilot with his view unobstructed directly above his head has in front of him an automobile mirror with a total curvature of 45 degrees, this mirror reflects an arc of over 90 degrees, so that it can be put in a position such as to reflect any machine approaching directly from behind or flying vertically overhead or between these two points. It is very important that such mirrors be introduced in training machines, for, in the first place, this enables the pilot to avoid collision and, particularly, when flying in formation, to watch both the man in front of him and the man behind him. In the second place, if there is another man behind him he can watch that man and see if he is all right and see any signals that he may wish to make. In the third place he can watch all parts of the machine behind him. There should immediately be bought an adequate number of such standard mirrors as are available for immediate use, and they should be promptly put in use. Meanwhile, mirrors with a somewhat greater diameter, but with a smaller radius of curvature than the standard automobile mirror, so as to give a scope of at least 90 degrees reflection, should be manufactured and placed in use as rapidly as they are available ,for such mirrors would be more effective for this particular purpose than the standard type of automobile mirror.

—Losses

[1059 Airplanes Bagged in March. *Canadian Military Gazette,* Apr 9, '18. 155 words.]

Up to the last night of the month, 1059 airplanes were reported as brought down on all battle fronts in March. Of these the Allies claimed 838 and the Ger-

mans 221. All but a relatively small fraction were the result of the intense fighting on the Western front, the allied figures being 740 and the German figures as given above. The balance consists of machines reported brought down on the Italian, Palestine, Macedonian and Mesopotamian fronts. The total of 1059 exceeds any return for any one month since the war began. Hitherto the highest had been in April, 1917, when the number of 717 was the nearest approach. This was followed with 704 in the following September.

—Manufacture of Airplanes

[Technical Considerations of Materials Employed in Aeroplane Construction. By O. Pomilio. *Aerial Age Weekly*, Nov 15, '17. 2730 words. Illustrated.]

It has often been said that the wood construction and the wood and steel construction now employed in airplanes will be replaced by an all metal construction. Wood has its defects and among these is its property of absorbing moisture. The present system of mixing wood, tubing and steel wires in the construction gives a remarkable combination of elasticity, strength and light weight. There are several kinds of hard woods used and these vary according to the functions of the various parts and to the stresses to which they are subjected. The members subject to flexure, impact, etc., are generally made from hard wood, having elastic properties; those members subject to compression are made of resinous wood, which is not as strong but is lighter. In every case the wood must not be rotten or in a decayed state. It must be hard, homogeneous in structure, straight grained, and without knots or other defects; it must also be well seasoned and dry. Among the hard woods, ash, hickory and walnut are the ones most used. Walnut is used most in propellers. It must be hard, uniform in structure and very close grained. Among the resinous woods we have ordinary spruce, Norwegian spruce and the pitch pines. The soft woods are used in airplanes to make the cross for wing ribs, or accessories, such as tank supports or foot rests. Of the soft woods we may note poplar, birch and linden tree. Various things have led the constructors to adopt hollow sections. As hollow members are generally made in two halves glued together, these two parts are joined so that the tendency one part has to warp will be neutralized to a large degree by the warping action of the other part.

The German military authorities specify that all wooden parts in the vicinity of the cockpits be wound with cloth, in order to avoid splinters being formed. The glue used must be very liquid and applied warm, and, if possible, the surrounding air should be heated. The glued parts are then pressed together with screws. Steel, aluminum, copper and its alloys are all used in airplane construction. Steel is used not only in wire stays, cables, turnbuckles, motor base plates, etc., but also in special tubing in the landing gear or chassis, the fuselage and the wings. For members subject to abnormally high stresses, steel of high per cent elongation must be used. The steel used in the manufacture of pivots, bolts, turnbuckles, and members subject to high impact stresses or to strong vibration, must have a minimum per cent of elongation of 22 and must pass a cold bending test to an angle of 60 degrees and back to 180 degrees without developing any weakness. Steel sheets must be of uniform thickness and not show any cracks. The wire stays or piano strings are manufactured from high grade crucible steel having an elastic limit of 56,800 lbs. per sq. in. Besides being tested for tension, wire stays are subjected to a fatigue test.

The wire is held fast in a specially made vice having round jaws. It is then bent back and forth thru an angle of 180 degrees for a number of times. Turnbuckles and bolts must undergo a cold bending test to an angle of 45 deg. and back to 180 deg. without developing cracks. Steel tubing must be of uniform thickness, homogeneous in structure and not show any cracks. There are some alloys of aluminum light in weight but having much higher resistance than the metal itself. One of these is duraluminum. The density of this metal varies from 2.78 to 2.83, or slightly higher than that of aluminum. Its resistance, elongation, hardness and rigidity are the same as that of soft steel. Duraluminum can be forged, drawn, welded, pressed and threaded. The gasoline and oil pipes and the tanks are made of copper.

—Maps and Mapping

See

AERONAUTICS—RECONNAISSANCE BY

—Matériel

[On the Value and Use of the Large Airplane. By F. Handley Page. *Aviation*, Aug 15, '17. 3900 words. Illustrated.]

It is a well-known fact that large airplanes are absolutely necessary when great distances have to be traveled or great weights be carried. The high speed type of machine on account of its small margin of weight available for carrying loads is of little value except for short distance fighting or high speed performance. For carrying great loads or flying long distances the speed must be decreased from 130 miles per hour to 100 miles per hour or less and carry 21 lbs. per h.p. instead of 7 or 8 lbs. per h.p. As the great armies in Europe are separated from each other by very short distances an hour or two's flight will display the entire defensive works of the opposing side. The carrying out of this reconnaissance work entails considerable risk and for the protection of the reconnoitering machine it is essential that fighters accompany it. Due to the rapid development of the airplane it is quite possible that the whole system of warfare may undergo extensive alterations in the very near future. The large multi-motored type of machine is capable of flying considerable distances with heavy loads and on account of its great size more comfort is afforded to the crew and long distances may be covered with less strain on the personnel. The large multi-motored machine can land when and where it pleases as it is not forced to land when one engine breaks down. Hence this type of airplane more than any other eliminates the element of uncertainty which makes the more extended use of the airplane prob-

AERONAUTICS—Continued

lematical. The failure of one engine reduces the speed, but it cuts down the gasoline consumption accordingly so that a greater distance can be covered at reduced speed. These considerations are likely to alter current ideas in regard to the use of seaplanes. If we can discount the eventuality of forced landing, we can do away with the boat and use the ordinary military airplane for naval service. This type of machine could be made particularly suitable to the needs of the United States in the present war. This problem may be dealt with under two headings. I. Co-operation with the Allies on the Western Front. II. Submarine patrol work.

While it is true that a number of bombing raids have been conducted in the past, these expeditions never extended over great distances, and the load of bombs that has been dropped on the enemy's interior lines has been a limited one. With the use of large squadrons of multi-engine airplanes this situation would be materially altered. If one imagines a fleet of several hundred of such machines, each carrying one, two, or even three tons of bombs, penetrating after a flight of many hundred miles into the very heart of the enemy country and destroying with high explosives the manufactories which are essential to the provisioning of the people and the munitioning of the armies, it will be evident that we should be able to strike a blow at the very backbone of the enemy's armies.

No gun can, at the present time, fire the distance, or deliver so much explosive at a given spot as the airplane, and but few guns are able to produce the same effect over much shorter distances.

The well-known American ability for quantity production, as well as the large number of enthusiastic sportsmen that is to be found in the United States, would make an ideal combination for realizing a great bombing campaign against Germany. It is essential that it be carried out by night, for, given adequate instruments, a place can be reached by night just as surely as by day, while on the other hand there is less likelihood of losing machines by anti-aircraft fire or hostile airplanes. The wing tips and the tail of each airplane are illuminated with small lights, so that each pilot can see the other machines and avoid collision. The navigating instruments are also lighted electrically and by the aid of these the pilot is able to steer the airplane to its destination.

Several of the big machines carry heavy guns, and these go into action on the searchlight control batteries. Lightened of their load of bombs, they are able to outfly the defenders, and their ability to climb more than outweighs the pursuit machines' extra speed. It is easier to land a large airplane in the dark than a small one, for large machines pull up quicker on the ground, and owing to the cushioning effect of big planes on the air between them and the ground, the alighting speed is smaller than in the case of the small airplanes.

For bombing work, the large machine is the ideal one. It is essential when bombing that the platform should be steady, and that the man in charge of the bombing should have plenty of comfort, so that he may drop the bombs with some accuracy. A large machine affords a splendid platform on which to lie, excellent sighting opportunities, and great all-round steadiness.

The great point in favor of an airship for naval patrol is that it is able to remain in the air with the power shut off, the men in the car are comfortable, and thus an excellent observation station is obtained for observing any hostile ships and sending back a wireless message to the base. Owing to the large size of the airplane, a one, two, or even three pounder gun as well as many bombs can be carried, and if it is not possible to reach the hostile ship or submarine before it submerges the gun may be used with effect where the bomb could not be dropped, owing to the distance of the target. A fleet of such airplanes could continuously patrol 300 to 400 miles out to sea and effectively protect in daytime the shipping lanes by escorting incoming and outgoing vessels, and thus reduce the submarine's ability to destroy commerce. A large airplane of, says 600 h.p. can carry a weight of 20 lbs. per h.p. or 12,000 lbs. of weight, half of which is effective load, so that we get a useful load of 10 lbs. per h.p. or 6000 lbs. A machine of the type herein described having accidently landed within the German lines, the following dimensions and performance data may be published: Span 100 ft., area 1700 sq. ft., gross weight fully loaded 11,500 lbs., weight machine bare 6500 lbs., h.p. 540, two 270 h.p. Rolls-Royce engines, speed range 40 to 90 m. per hr., climb 10,000 ft. in 30 min., fuel capacity 2900 lbs., engine consumption full power 325 lbs. per hr., endurance slightly throttled 11 hrs. To carry bombs either the fuel could be reduced or the load could be increased by 1000 lbs., as done in trials. The designed bomb capacity is 16 sixty-five lbs., one hundred lbs., or one hundred and twelve lbs. high explosive bombs.

The maximum load of bombs that could be carried is 2000 lbs, with three machine guns and ammunition. Actual experience has proved that where military objectives are well protected by anti-aircraft guns, attack by aircraft should be made at night. The use of large airplanes by day would be scarcely permissible over areas strongly defended by anti-aircraft guns as good results are obtainable with guns up to 14,000 ft. Among the most notable performances of the Handley Page machine may be mentioned: Height of 7180 ft. with 22 men aboard, a height of 13,000 ft. with full load, a flight from London to Paris in 2 hrs. and 10 min. and a flight from London to Rome with a crew of 5 men in 7 hours total flying time.

—Matériel

[Aeronautical Developments. By P. M. L. *Mem. de Ingenieros*, Feb, '18. 3200 words. Illustrations.]

During the present war military aeronautics have attracted great attention by the marked progress towards efficiency. Considering first the captive and dirigible balloons, we see that the beginning of this period the captive balloons were spherical in shape, thus pre-

senting great difficulties to the observers on account of their continual turnings and oscillations, which at times would make an observer seasick. The German types Parseval and Sigsfeld, designed to remedy this defect, are too well known in Spain to need any description. (They are two passenger balloons of elongated comet-like shape.) France started this war with the obsolete spherical type, but now uses a type very similar to the Parseval.

At present, in spite of the advances in airplanes and dirigibles, the captive balloons are much used, chiefly for directing artillery fire and overlooking nearby terrain; at the same time they are used in the defenses of London against bombing, being armed with small guns for this purpose.

At the beginning of the war France and Germany led in the construction of dirigible balloons, especially Germany, where two principal types were developed, the flexible for short range flights and small cargo, and the rigid or Zeppelin for large cargoes and long trips. France preferred the semirigid type as giving greater cargo capacity for the same size, altho not so well adapted for high speed. As an example of the size now reached, a Zeppelin recently downed in England was 200 meters long, 25 meters in diameter, had five motors of 250 h.p. each and could rise to an elevation of 7000 meters. These great dimensions give numerous advantages to the Zeppelins, but it is believed by the English that the consequent disadvantages more than outweigh the benefits. Armament of these machines is limited to rapid fire guns for defense and to bombs for attacking land defenses. Ingenious devices are provided for timing the discharge of these bombs according to the height and speed of the machine.

The more important military uses of these machines are exploration, especially at sea, and the bombarding of ports and other important areas. It is necessary to rise to only 500 meters above the sea to overlook an area of 100 miles in diameter which would require several hours' work by a number of fast boats to inspect. In addition, under favorable conditions they are able to locate mine fields and submarines at small depths. It is hoped that further improvements in silent engines and stability of construction will materially reduce the dangers from weather and enemies.

Airplanes. At the present time these are the most important branch of military aerial machines. At the beginning of the war they were limited in number and very ineffective as military machines, as they had not been developed under the spur of necessity. They have since greatly increased in number and in value. Various military uses have necessitated the installation of various devices, such as machine guns, wireless apparatus, photographic equipment, and aiming devices for bombing. It has been found necessary to specialize the pilots for using different types of apparatus, as well as the observers who have to take charge of the machines in case of accident to the pilot. This has come from the development of distinct types of machines, such as the combat airplane, the reconnaissance airplane, and the bombing machines. These names indicate the purposes for which intended. The machines are grouped for work into units, or squadrons, each composed of the same type of machines, which are identical thru the squadron.

[Military Aeronautics. By Eduardo Garcia. ***Mem. de Ingenieros,*** May, '18. 7000 words. 5 figures.]

One of the strongest lessons of the present world war is the necessity for nationalizing all industries, and especially the industry of making war. To this end it is essential that all the products needed in war should be produced within our country; we should not content ourselves with developing raw material which is imported, for in a war such as the present few countries are able to import unlimited quantities of raw materials. It is believed to be particularly essential that all the raw material for the air service should be produced within the country. (The writer deals especially with lighter than air machines.)

This desired result may be obtained in two different ways, by developing large private industries which may be taken over by the war department during war and by developing large government plants under the war department. In the first case, the work would be done under government supervision, in the second it would be done by the army itself. From motives of ultimate economy it is believed that the first would be more likely to be adopted; nevertheless, it is recommended that this work be done by the army itself in order that the machines be developed of types and in quantity which may satisfy the military authorities.

(A detailed description of the types of factories which would be needed and the general plan of construction of these factories is given; this is not believed to be of general interest, especially without the figures.)

[War in the Air. By "Aeronautics." *Army & Navy Gazette,* Aug 3, '18. 1000 words.]

The writer notes that by far the greatest danger to the fighting aviator is from fire. He decides that, so long as liquid fuel is used, this will be impossible to prevent and argues armoring of airplanes devised for low altitude work, believing economy will be procured by protection from incendiary bullets, tho speed, etc., will be lost.

[War in the Air. By "Aeronautics." *Army & Navy Gazette,* July 6, '18. 1000 words.]

Deliveries of airplanes in March, April and May of this year were 116 per cent in excess of those in June, July, and August, 1917. Of engines 105 per cent. In America $163,000,000 has already been expended in aviation and Liberty motors are being turned out at the rate of 100 a week. America has ordered 14,000 foreign airplanes, of which 1800 have been delivered, while 8000 foreign engines have been contracted for of which 1500 have been delivered. There are about 1300 aviators flying with the A. E. F.; there are about 5000 men physically fit and ready to enter the flying service, and there are 15,000 flying and non-flying Aviation Service officers in the United States and France. One hundred Liberty motors had been shipped to France in May, which has ordered 10,000 from the U. S. Government. The Liberty motor developed 400

AERONAUTICS—Continued

h.p. with a weight of 800 pounds and stood up wonderfully, in endurance tests. The Packard Motor Car Company will soon be turning them out at the rate of 15 a day, while the Ford Company expects to produce 100 a day in the near future. We cannot have too great a supply of machines as the strain on airplanes is very great and becoming greater, due to increased activity of the air forces in bombing, etc. This article also gives a summary of the air activity during June. 1061 airplanes were reported downed in June on all fronts. Of this number the Allies claimed 591 and the enemy 210 on the western front alone.

Germany

See also
A. E. G. Airplane

Great Britain

[An Airplane Which Folds Like a Jack Knife. *Scientific American,* Dec 8, '17. 275 words. Illustrated.]

The British have developed airplanes with folding wings so as to economize in storage space. In a type of folding-wing seaplane, the planes, which are hinged to the forward part of the fuselage, can be swung back until they are alongside the fuselage. The folded seaplane can be accommodated within a space of 10 ft. by 30 ft. instead of the usual space of 40 or more feet by 30 ft.

United States

[American Made Airplanes on Way to French Front. *Official Bulletin,* Feb 21, '18. 1250 words.]

The first American-built battleplanes are to-day en route to the front in France. This first shipment, tho in itself not large, marks the final overcoming of many difficulties met in building up this new and intricate industry.

These planes are equipped with the first Liberty motor from machine production. One of them in a recent test surpassed all records for speed and climbing for planes of that type. Engine production, which began a month ago, is now on a quantity basis and the peak of production will be reached in a few weeks. Only the 12-cylinder type is being made, as developments abroad have made it wise to concentrate on the high-powered engine instead of the eight-cylinder.

These statements should not be exaggerated but should be considered in the light of the following facts: After three years of warfare the total number of planes able to take the air at any one time on either side of the western front has not been over 2500. This, combined with the fact that 46 men are required on the ground for every plane in the air, gives a truer perspective of the European aviation situation than commonly possessed.

For every plane in the air, there must be two replacement planes on the ground, and one training plane for every pilot who eventually reaches the front, with a spare engine for each plane.

—Medical Aspects of

[Some Aero-medical Observations. By Maj. R. N. Greene, M.C., Fla.N.G. *Military Surgeon,* Nov, '17. 4300 words.]

(A description of certain studies and observations made by the writer for the purpose of gaining some idea of the medical aspects of flying. The observations were unfortunately cut short by the sudden relief of the writer's command from the duty on which it had been engaged.

A considerable portion of the article is taken up with an interesting description of the feelings of a person upon first beginning to fly. The medical data obtained are summarized.)

Even at great heights there is no dizzy sense of the height such as one gets from standing on a high point and looking down. This is believed to be due to lack of perspective.

Blood pressure readings were made at various heights. The normal readings on the ground were from one hundred and ten to one hundred and twenty. At an altitude of 6000 feet the pressure was habitually elevated to two hundred. There was little change from 6000 to 11,000 feet altitude. A mild tumultuous heart action was noticeable at considerable heights. There is also a peculiar chilling such as is experienced nowhere else. The extreme cold affects the body temperatures in prolonged flights. At great heights it was impossible to make clinical thermometers register at the normal point, even tho held almost entirely within the mouth for several minutes.

Hemoglobin indices, following the Talquist index, showed a persistent fall of ten degrees in coloring matter after landing from altitude flights. This was a constant feature day after day, the return to the normal percentage invariably occurring before the next day's flight. Fluctuations of six or eight pounds in weight were not unusual.

[The Effects of High Altitudes Upon the Efficiency of Aviators. By Maj. E. G. Seibert, M.R.C. *Military Surgeon,* Feb, '18. 1200 words.]

It is a well-established fact that airplane pilots show marked evidences of nerve breakdown in greater or less time, according to the individual. Early in the war this was attributed to the stress of circumstances. It was finally discovered, however, that a more potent underlying cause was the decreased quantity of oxygen going into the blood. As the war progressed, the altitudes to which pilots were forced to ascend became greater and greater, and these evidences became greater and greater likewise.

The term *respiration* is usually applied to the intake and output of air from the lungs. As a matter of fact, however, respiration further implies the gaseous interchange in the terminal portions of the bronchial tree; the taking up of oxygen into the blood, and the later surrender of the oxygen by the blood, giving to all the body processes those phenomena which constitute life.

The percentage of oxygen in the atmosphere remains constant irrespective of the height. The partial pressure, or tension, however, diminishes in a somewhat progressively proportional manner with the decrease in barometric pressure. It is the oxygen tension

in the lungs which is most important in maintaining the respiratory process.

(A table is given showing the relation of barometric pressure and oxygen tension to elevation. As examples of the manner of this variation, the oxygen tension at sea level is 101.32; at 10,500 feet elevation it is 51.09; at 16,500 feet it is 30.16; while at 21,000 feet it has dropped to 17.30.)

As the transfer of oxygen to the blood depends in part upon the oxygen tension, it can readily be seen why oxygen want should promptly ensue on reaching high altitudes. One other factor in this transfer of oxygen to the blood is the activity of the cells lining the alveoli. This introduces the individual factor into the question and explains why some may go to these heights with less resulting symptoms than others. Acclimatization, or the acquired ability to withstand high altitudes, has been studied by the British Air Board without satisfactory results as yet.

In altitudes above 18,000 feet, where the barometric pressure is half that at sea-level and the oxygen tension is reduced to one-fourth or less, the blood is quickly deprived of the necessary oxygen to carry on the body processes. This allows the accumulation of those substances which bring on a pronounced auto-intoxication, the effects of which are peculiar and especially dangerous to an aviator. One of these effects is an extraordinary impairment of judgment. Among others reported by aviators are panting, difficulty in concentrating attention, headache and fatigue, noises and pains in the ears, vertigo and vomiting.

Unfortunately prime physical fitness is not always a guarantee that the subject will be free from these symptoms of nerve instability. The fact of individual susceptibility points to the necessity for careful selection of the men who are to perform this duty of flying at high altitudes.

—Motors

See also

PEUGEOT MOTOR

[Aviation Engines with Particular Reference to Benz and Mercédès Types. By E. H. Sherbondy. *Aviation*, Sept 1, '17. 3455 words. Illustrated.]

The Mercédès Engine.—The 150 h.p., six-cylinder Mercédès engine, which is 5½ in. bore and 6 5/16 in. stroke, won all the important places in the Kaiser prize contest with the exception of the first prize, which went to the Benz. The principal features of the design are forged steel cylinders, with forged steel elbows for gas passages, pressed steel water jackets, which when welded together form the cylinder assembly, the use of inclined overhead valves operated by means of an overhead cam shaft thru rocker arms which multiply by motion of the cam. The construction is necessarily very expensive. In the Mercédès engine the pistons have a drop forged steel head, which includes the piston pin boss, and this head is screwed into the cast-iron skirt which has been machined inside to secure uniform wall thickness. The carburetor used on this 150 h.p. Mercédès is precisely of the same type used on the twin-six engine; it has two venturi throats, in the center of which is placed the gasoline spray nozzle of conventional type, fixed size orifices. Immediately above this are placed two panel type throttles with side outlets. An idling or primary nozzle is arranged to discharge above the top of the venturi throat. The carburetor body is of cast aluminum and is water jacketed. The only abnormal thing in the design of this engine is the short connecting rod, which is considerably less than twice the stroke and would be considered very bad practice in motor-car engines. Other features of the design are a very stiff crank case, the halves of which are bolted together by means of long thru bolts, while the crank shaft main bearings are seated in the lower half of the case, instead of in the usual caps.

The vertical bevel gear shaft thru which the drive is taken from the crank shaft to the cam shaft operates at one and one-half times the crank shaft speeds, and the reduction to the half-time cam shaft is secured thru a pair of bevels. On this vertical shaft there are mounted the water pump and a bevel gear for driving two magnetos. The water pump mounted on this shaft tends to steady the drive and avoid vibration in the gearing. The largest Mercédès engine has recently had its horsepower increased to 176 h.p. at 1450 r.p.m.

The Renault Engine.—The next engine to be considered is the V-type, twin-six Renault of 4 in. bore and 6 in. stroke. The first important peculiarity of this design is the small angle between cylinders, which is only of 47½ deg., enabling the body to be considerably narrowed in width, thus reducing the head resistance. The cylinders are almost duplicates of the Mercédès design of steel cylinder, with the exception that the elbows in which the valves are inserted are not so carefully designed, and the water jacket is carried around only one side of the exhaust valve stem, whereas in the Mercédès the water jacket completely surrounds the exhaust valve stem. Each of the cylinder bands, together with the head, are machined from a forged bar, after which the intake and exhaust elbows are welded on, and finally the pair of cylinders are encased in a jacket, which is welded up from three pieces of steel approximately 1/32 in. thick.

The pistons are of cast iron, and are the only very heavily designed pieces in the engine. The piston carries three concentrific rings, which are pinned at the ring gap and have a deep annular rib between the bosses. The connecting rods are of the articulated type, and the short rod is alternately arranged from right to left cylinder from the front of the engine to the back. The crank shaft is carried in four babbitt-lined bronze shells, which in turn are secured to ribbed steel bearing caps. The bearing caps are locked in the top of the case by means of long U-bolts, such as are sometimes used on automobile spring saddles. The carburetor differs from the Mercédès only in that it uses a single float chamber instead of two float chambers. There are two carburetors mounted on either side of the engine, bolted to either side of the crank case by means of long studs. The carburetor has a pair of primary nozzles, and an

AERONAUTICS—Continued

auxiliary air valve which consists of an annular ring mounted concentric with a venturi throat.

Oil is to be carried thru cast ducts in the front and rear compartments of the crank chamber to the main bearings. It is also carried from these ducts thru two copper tubes up to the overhead cam case and passes thru the cam shaft case from the propeller to the starting end of the engine, thence down thru the distributing gearing case to the oil pump.

There are four magnetos mounted on the same axis, each pair being driven thru a spur gear, which in turn meshes with a spur gear movably mounted on a splined magneto drive shaft. At the front end of the crank shaft there is mounted an aluminum six-cylinder, air-starting motor, which engages the crank shaft by means of an overrunning clutch. This air-starting motor has a single inlet discharge valve for six cylinders of the rotating disc type.

The Benz Engine.—This engine is a six-cylinder design and three different sizes were built and rated at 85, 100 and 150 h.p., respectively. We shall consider the largest which has six cylinders, 5⅛ x 7 1/16 in., and which weighs 510 lbs. complete. The fuel consumption is .50 lbs. per horsepower hour. The Benz cylinder is simple, straightforward and a very reliable construction, not difficult to manufacture. It is cast of iron without a water jacket, but including 45 deg. angle elbows to the valve ports.

The bottom and top of the cylinders become water galleries, and by this means separate water pipes, with their attendant weight and complications, are eliminated. Rubber rings held in aluminum clamps serve to connect the cylinders together.

The valves are operated thru a push rod and rocker arm construction which is exceedingly light. The cam shaft is hollow, and there is a spiral gear made integrally with the shaft, in about the center of its length, for driving the oil pump gear.

The seven bearing crank shaft is finished all over in a beautiful manner, and the shaft out of the particular engine we have shows no wear whatever. Thru both the crank pin and main bearings there is drilled a hole, and the crank cheeks are plugged with solder. There is screwed onto the front end of the shaft a piece which forms a bevel water pump driving gear and the starting dog. Long-shouldered studs are screwed into the lower portion of the case and pass clear thru the bottom of the case.

The pistons are of cast iron, and carry three concentric rings, ¼ in. wide, on their upper end. These are pinned at the joint. The piston pin has a hole bored straight thru, and is retained in the piston by means of a threaded taper pin which screws into the piston pin boss. The end of the piston pin is slotted so that the taper pin expands the end of the piston pin and forms a very certain retention. The oil pump assembly comprises a pair of plunger pumps which draw oil from a separate outside pump, and constructed integrally with it is a gear pump, which delivers the oil under about sixty pounds pressure thru a set of copper pipes in the base to the main bearings. The Benz company has produced a later design with four valves per cylinder of the same size, namely, 5⅛ in. x 7 1/16 in., which gives 225 h.p. at 1500 r.p.m.

The Austro-Daimler Engine.—This engine used an offset crank shaft. In my estimation the intake pipe and carburetor arrangement on the Austro-Daimler are the best of any of the aviation engines. The lubrication also is different from any other aviation engine, since individual high pressure metering pumps are used to deliver oil only to the bearings and cylinders.

It becomes more and more apparent that engines of less than 200 h.p. have only a limited field. What we need immediately in America is a large number of training planes; but we will also have to have battle planes driven by engines that are not equal to, but are superior to, those possessed by the enemy. The really important thing about aeronautic engines from now on is going to be the number of cubic feet of mixture per minute that they can handle, and in connection with four-stroke cycle motors this points out the necessity of using relatively high speeds.

[Means of Obtaining High Volumetric Efficiency for Aviation Engines. *Aviation,* Oct 15, '17. 2250 words. Illustrated.]

The one and most important point in the design of aviation engines is the matter of reducing the weight of the engine per developed horsepower, without sacrificing the factor of safety and the reliability of the different parts of the engine.

If the developed power of the engine can be increased without adding more cylinders or changing the dimensions of the cylinders, and simply increasing the strength of those parts which are submitted to the additional strain, such as connecting rods, crankshaft, wristpins, etc., it is obvious that a material gain in horsepower per lb. engine weight can be obtained. Increased developed horsepower can be obtained in two ways, either by increasing the number of revolutions of the engine per minute, or by increasing the mean effective pressure in the cylinder; or again, by a combination of both. It was not found practicable, from the early days of the aviation engine until the last year, to run the engines over 1400 r.p.m. due to the fact that the slippage of the air propeller would become so great at speeds above 1400 r.p.m. that no increased traction could be obtained. In order to maintain a propeller speed of 1400 r.p.m. and still obtain the increased efficiency of the higher speed engine, the development of the geared down engine was taken up. It is generally found, in comparing a geared down engine running at 1700 r.p.m. with an engine of the same cylinder dimensions and valve construction but running as a straight drive at 1700 r.p.m., that the weight of the gears offsets the increased power output due to the increased engine revolutions. The total horsepower per pound becomes approximately the same in both cases, and the less complicated straight drive engine is usually preferred.

The only remaining means of increasing the de-

veloped horsepower without increasing the cylinder dimensions or the number of cylinders is, therefore, to increase the explosive pressure, or mean effective pressure, by increasing the charge of gas into each cylinder. A compression ratio of 16.5 per cent to 17 per cent is all that can be used, and an engine with this compression ratio cannot be run with wide open throttle under full load on the ground for more than 10 to 15 minutes at a time without risking unnecessary damage to the crankshaft bearings, due to the excessive vibrations. The ways of increasing the charge of fuel in the cylinders for each explosion can be divided into two classes, the normal intake, where the downward stroke of the piston creates the vacuum necessary to fill the cylinder with gas, and the forced intake, where by some means the charge is forced in under pressure. The ratio of charge drawn in varies with the engine speed and temperature. It will, in a hot engine, decrease at first rapidly with increasing speeds, then less rapidly, and finally become constant or increase at speeds of 1300 to 1400 r.p.m.

The construction that will give the most open area for the intake valve is the most desirable, and will produce the most power. This is generally obtained by using two intake valves per cylinder. The disadvantage of the two valves per cylinder lies in the complication in the system of rocker-arms and camshaft, which can, however, be somewhat offset by using forked rocker-arms so that both valves are operated by the same cam and the same rockers. The question of exhaust valves is somewhat different. The main point here is not to avoid resistance in the expulsion of the burnt gases, as these are not driven by a vacuum, but by a positive pressure force. The point of most importance is here to provide sufficient cooling of the lower part of the valve. Where the construction of camshaft and cylinder head will allow it, it will be found advantageous to use four valves per cylinder. Heretofore it was, and it is yet in many cases, common practice to have the design of the intake and exhaust valves alike, so that the valves are interchangeable. Lately the tendency has been to design the intake valves with more direct regard to the free flow of incoming charge. The most disturbing effect in the distribution of the gas from the carburetor to the cylinder is the creation of eddies in the incoming mixture. Intake valves with a cone shaped power port, or with a heavy fillet have given very good results. The exhaust valves have also undergone several changes.

Another point which is of vital importance in reliability and endurance is the proper cooling and water-jacketing of the exhaust valve seat and exhaust valve stem. There is always a limit to the charge that can be drawn into the cylinders thru normal suction, and in order to further raise the horsepower output of the engine the designer must look toward intake or supercharge as the technical term has been designated. It has been attempted to supercharge the cylinders in different ways. So far only one has proven successful, that is to take in a charge of overrich mixture thru normal piston suction and then admit pure air at the bottom of the intake stroke under pressure. In a supercharged engine, where a larger body of charge is burned under the same compression, the initial pressure will be somewhat higher, but the most important point is that the pressure will decrease much more slowly. The additional power is obtained after the combustion has taken place, rather than in the moment of the combustion. It is possible with supercharged engines to vary the compression with very simple mechanical arrangements, by varying the pressure of the compressed air admitted to the cylinder at the bottom of the intake stroke, so the correct compression can be maintained at all altitudes to which the airplane may ascend.

[The Cleveland Aero Engine. *Air Service Jour.*, Feb, '18. 900 words.]

The Cleveland aero motor was designed by Walter C. Willard. The engine parts are so standardized that the same parts, with few exceptions, may be used in the assembly and repair of any size engine from 100 to 600 h.p. and, as the design is very simple, the engines may be produced with sufficient accuracy under forced production.

The Model 4, 150 h.p., has six cylinders, arranged with their axes parallel to the drive shaft. Each cylinder transmits its power to a single throw crankshaft, each crankshaft having a bevel gear which meshes with a large gear on the propeller shaft.

The cylinders are designed and supported in such a way as to minimize the stresses due to changes in temperature. Strains due to combustion at the piston-head are taken up by a pair of steel alloy studs so placed that each main bearing is hung in a sort of U-shaped saddle, the studs passing clear thru the cylinder heads.

Two intake and two exhaust valves are provided for each cylinder. One cam is used for all intake valves, and one for all exhaust valves. The valves are interchangeable and each pair of valves is operated thru a single bell crank and push rod.

The engine is water cooled. The gas intake manifold and the water intake and outlet are all incorporated in a single casting forming the cylinder heads.

All the lubrication required is secured by the running of oil on the large gear on the propellor shaft. This gear throws the oil about to properly lubricate other parts. The excess oil is pumped from the oil case and used over again.

The ignition system is so arranged that either two magnetos, a magneto and a battery, or two batteries may be used. The plugs are located so as to have complete combustion take place in the shortest time possible, and so that there is no danger of their coming in contact with any oil which might possibly accumulate. The plug bosses are completely surrounded with an ample supply of water.

The engine may be started by cranking from the machine, by cranking from the propellor end, or the engine may be fitted with any type of self-starter. The mounting is of the three point type.

Materials have been chosen which offer strength

AERONAUTICS—Continued

and endurance qualities, and each alloy is chosen so as to be fitted for the particular work required of it.

The crankshafts are forgings of chrome-nickel steel, carbonized and heat treated. Connecting rods are of the same material differently heat treated.

The large gear and drive pinions are of the same material so carbonized and heat treated as to give long life. The main drive shaft is also of the same steel alloy. The bearing supports are of manganese bronze. The cylinders are of 30.40 point carbon steel tubing, with jackets and the plug bosses welded to the steel tube. The combination cylinder head and manifold are an aluminum casting. The pistons are of aluminum alloy, and have three rings each. The valve seats are of phosphor bronze and are easily replaced.

[Airplane Engine Efficiency. By Aviator. *Air Service Jour.*, Apr, '18. 1000 words]

In airplane flight it is important to know the efficiency of the motive agent dealt with. The pilot should know the ratio of the useful work his machine does, or the effect produced, to the energy expended in producing it. Efficiency is the ratio of the work got out to the work put in.

Consider the efficiency of the airplane:

1. Energy is expended by the explosion of vaporized gasoline which sets the engine working.

2. Energy is expended by the engine, which sets the propellor working.

3. Energy is expended by the propellor, which causes the airplane to lift.

In all three cases, the useful work accomplished is far less than the work put in.

In case 1 the efficiency is very low as the gases escape from the combustion chamber with a great deal of heat which is not turned into work. The actual percentage of efficiency is only 21.

Case 2 deals with the efficiency of the mechanism of the engine. There is quite a loss of useful work, due chiefly to friction, the power calculated in the cylinders, that is the indicated horsepower being greater than the brake horsepower, which is the net horsepower shown by a friction brake on the shaft. The brake horsepower varies from 65 to 85 per cent of the indicated horsepower, generally the figure 80 per cent is used.

In calculating the indicated horsepower, it usually is necessary to make indicator cards. However, for ordinary calculations one can use 80 lbs. per sq. inch as the mean effective pressure during the power stroke, remembering that in the 4-cycle engine there is one power stroke in four strokes.

In case 3, the useful work accomplished is also low, the distance the propellor travels forward in one revolution is far less than the pitch of the propellor, that is, the distance it would travel forward if there were no resistance. The difference between the pitch of the propellor and the actual distance traveled is known as the slip of the propellor. In other words, the slip of the propellor is the useful work lost.

[Aviation Spark Plugs. By O. C. Rohde, M.E. *Aerial Age Weekly*, Feb 4, '18. 1850 words; illustrated.]

We have for some years given time to the study of spark plugs for automobiles and for all sorts of automotive engines. There are two very good reasons for making a separate study of spark plugs for airplanes. The aircraft engine is different in many ways from the ordinary automobile engine. We have had to secure extreme power at reasonable engine speed and at a minimum weight per horsepower. That in turn means increased compression. Increased compression means higher temperatures, and higher temperatures require better spark plugs. We have many good plugs, but we cannot say at this time that we are absolutely sure that each one of a given set of plugs will give a certain specific performance in an engine. In this country, long and laborious engineering research was necessary to develop insulators from the materials at our command. Years ago we could import materials easily and were not pushed to develop insulators from our own resources of raw materials.

There are three essential elements in a large spark plug: 1—The insulator; 2—The electrodes; 3—The general design and construction. Insulators are of two kinds: mica and ceramic. All mica cores are made up of thin sheets of mica, either in the form of laminated washers, or in the form of sheets wound around a central spindle. A few drops of oil on a sheet of mica will change it from an insulator to a conductor. On this account, if the core is not perfectly wound, and if there is any space, however small, between the layers of mica the plug will short circuit in a very short time on account of the accumulation of oil between the layers. The only way to find out the possible life of a mica plug is to actually run it in the engine.

Ceramic insulators are a baked clay product; usually some form of porcelain. Spark plug porcelains must have four properties to be of value: They must be mechanically strong; they must be able to stand sudden heat changes without cracking; they must have high electric resistance when hot; and they must have a surface which will resist fouling. Porcelain is inherently mechanically weak. A satisfactory method of tying the porcelain together from top to bottom has recently been developed which holds the spark gap rigid and permits of running even after a plug is broken. Porcelain in spark plugs must stand terrific heat shocks. Some engines when started cold, show a jump in average temperature in the combustion chamber, from room temperature to 900 degrees F Perhaps the most important point to be mentioned about spark plug porcelain is, that it must retain its insulation resistance at high temperatures. Average combustion chamber temperatures above 1400 degrees F. have been measured. Many of our standard spark plug porcelains which show a cut-out temperature much below this, have gotten by nicely on land engines. In aircraft engines we need a factor of safety, so that the porcelain which can show the best factor of safety in this respect, is worth a thoro trial.

A deposit of oil sticking to a porcelain may also conduct the current away from the gap and give a condition called "surface short," *i.e.*, the current passes over the surface of the porcelain thru the conducting part of the oil coating.

The second important factor in spark plugs is the electrode wire. It must be a good heat conductor; it must be a good electric conductor; it must be absolutely non-corrosive, and it must not expand sufficiently to split a porcelain whch has a low co-efficient of expansion. Nickel manganese has proven the best metal for electrodes.

The third important feature of spark plugs is design and construction. A spark plug is a small article, but there are many details to consider in its design. Too heavy an electrode wire may cause premature ignition. Too light a wire may warp in heat and change the gap. If we can get the safety factor mentioned above for our porcelain, we can be less particular in regard to a slight leak. It is important that heat be carried away from the sparking points as rapidly as possible. That means a shell construction with as much radiating surface as possible.

In Conclusion. We are just in the beginning of aircraft spark plug development. The war is lending impetus to the work of advancement. As a result we shall have in the near future the perfect plug for all purposes—at least a plug with a sufficient factor of safety to insure the lives of our boys who are fighting for us in the air in Europe.

—Naval Use of

[Progress in Aeronautics. By Major H. Bannerman-Phillips. *United Service Mag.*, Mar, '18. 3000 words.]

A recent interesting development in the use of aircraft for purely naval purposes occurred Jan 20 in connection with the sally of the *Sultan Selim* (ex-*Goeben*) and the *Medilli* (ex-*Breslau*) against the British forces at Imbros. Aircraft assisted in attacking and following up these vessels, and their action combined with that of the destroyers sufficed to drive the *Sultan Selim* and the *Medilli* into minefields where the *Medilli* was sunk and the *Sultan Selim* damaged so that she had to be beached at Nagara Point.

In this position the aircraft continued their operations against the *Sultan Selim*, dropping in all seven tons of bombs in the forty-eight hours ending Jan 26, with the loss of but one machine. The *Sultan Selim* was subsequently refloated.

Consideration of the possibility of aircraft operations against the German High Seas Fleet in harbor shows that our aircraft would necessarily be at a serious disadvantage in such operations by reason of the bombs, the fuel necessary for a long journey, and the necessity of running the gauntlet of powerful anti-aircraft defenses. However, the successful use of aircraft against the *Sultan Selim* opens up a new field of aerial offensive.

The vast development of aircraft in this war indicates as possible a substantial use for aircraft after the war for commercial purposes. In this connection, the improvement and perfection of the engine will be the main essential to commercial success of aerial transport. Engineering training will be of increased importance. Last October (1917) an important meeting was held looking toward better co-ordination in this branch of training. Many engineering and technical societies were represented. Three special proposals were made and unanimously adopted, as follows:

"(1) The co-ordination of engineering training, including the fostering of apprenticeship as a national institution, and the consideration of means by which the works period of engineering pupilage may be increased in efficiency and a wider appreciation secured for the value in industry of education of university rank.

"(2) The maintenance of a central bureau, where parents and guardians can obtain accurate and comprehensive information relative to the engineering industry, and the proper course to pursue on behalf of boys who are desirous of making engineering their profession.

"(3) The promotion of scholarships or other equivalent means by which the best talent may be enabled to rise to the proper level under the stimulus of educational opportunity."

The British government is prepared to second this scheme of scholarships, and the expenditure will contribute to the establishment of an engineering asset of great value in building up communications in the future.

With the increasing use of aircraft will come a cry against the danger involved, but the dangers will be no greater than those of present day foot-travel in cities. It is to be hoped that sympathetic regulation of aerial traffic will suffice.

—Night Flying

[The Mechanical Owl of the French Army. *Popular Science*, Jan, '18. 400 words. Illustrated.]

Night flying has become a military necessity for reconnoitering and bombing, as well as for attacking Zeppelins, which always work at night. Were it not for the fact that the average night sky is not pitch black, night flying would be very dangerous. It sometimes happens that, even on those nights when overhanging clouds cause everything to be wrapped in total darkness, it is necessary to send an aviator aloft.

The French have devised an equipment for the night plane which permits it to fly even on the darkest nights. There are three small searchlights in the middle of the lower plane which serve to illuminate the target or landing place when not too far away. To meet those cases where the searchlights are inadequate, the machine carries eight illuminating rockets, four on each side. They are mounted between the wings and can be fired electrically. Upon being fired, the rocket rushes far to the front and there emits a dazzling flare, which, suspended from a small parachute, lights up a large area.

These machines are comparatively slow. They seem especially intended to mother *avions de chasse*, which, because of their speed, rapid climbing and maneuvering ability, are particularly adapted for combat.

AERONAUTICS—Continued
—Organization and Administration

[Something Upon Aerial Warfare. By J. M. M. *Mem. de Ingenieros,* June, '17. 1500 words.]

(An article dealing with the progress made in aerial warfare since the beginning of the present European war. It deals with the organization of the aeronautical service of the French, English, German and American armies.)

[Air Power—Its Possibilities and Limitations. By Ladislas d'Orcy. *Air Service Jour.,* Mar, '18. 2500 words.]

Air power, or the mastery of the air, is often likened to the mastery of the sea. This comparison is correct in part only, for while either mastery implies the existence and suitable use of means wherewith to destroy the enemy's fighting strength, the results are not at all identical. To-day air power exists in only a latent state, but the aeronautical arm may be converted into a force in being that would actually insure the exercise of air power in a way similar to sea power. At the present time no belligerent exercises air power in a way to affect the outcome of the war because no belligerent has evolved a doctrine of independent aerial warfare, that is, independent of what should be the subsidiary functions of aircraft, namely reconnaissance and artillery direction.

The principal function of the fighter squadrons—the capital craft of the air—is the destruction of the enemy fighters. Once the latter are destroyed, or driven down thru technical or tactical superiority, simultaneous attack on the enemy's auxiliary aircraft, scouting and gun-spotting machines and upon his aerodromes, would be the next step.

As the aerial craft as insufficiently armed to meet successfully the attack of fighters, unless protected by similar machines, the destruction and scattering of the enemy's auxiliary machines would follow as a matter of course. The aerodromes would be attacked by bomber squadrons, possibly convoyed by fighters to prevent any surprise attack by some enemy fighters which might rally in a last-minute defense.

All this is based upon two assumptions: first, the existence of airplanes endowed with a much greater radius of action than is to-day the case, and, second, the constitution of an aerial shock force powerful enough to meet and defeat any concentration of enemy fighters. In other words, that there will come a time when upon declaration of war a battle air fleet will sally forth to meet the enemy battle fleet. The mastery of the air would then depend on the outcome of this engagement.

The principal difference between the sea fleet and the air fleet lies in the lifetime of the units which constitute the respective organizations. The airfleets of the battling nations are actually being rebuilt from six to eight times a year, due as much to the inherently short life of the airplane as to the necessity of constantly anticipating the enemy's improvements in aircraft technique.

Continual mastery of the air would then seem to imply one of two things. Either the bomber fleet accomplishes the destruction of the enemy's aerodromes, in which case it would seem quite possible to prevent any attempts at rebuilding them, or it fails and does not succeed in stopping the output and concentration of enemy aircraft. Then permanent mastery of the air will require that the continually renewed air forces be defeated every two months or so.

In aerial warfare a novel factor is introduced: the third dimension. Sea craft all move on a single plane and the dimensions are two. Aircraft adds to these dimensions a third, altitude. The plane of evolution is thus potentially multiplied. Such being the case, it is obvious that blockade operations will be materially more difficult in the air than they are on the sea. The high range of anti-aircraft guns will compel the blockading fleet to keep at such a high level that it will be unable to see what is going on. Observation by means of a cordon of aircraft drawn around the besieged aerodrome in a wide circle would achieve its object only if several cordons could be maintained at different levels. Anything short of such a net would defeat its own purpose, for it would afford the besieged the opportunity of breaking thru at a low level while the blockading air fleet was keeping station at a high level.

Local mastery is often achieved by a concentration of airplanes at a certain point. In order to effect such a concentration many a quiet sector of the line has to be stripped of its fighting squadrons, from which it follows that the belligerent who wanted to rule the air in a certain sector has to put up with the knowledge of being in other sectors inferior to the enemy's fighting strength and even risk partial defeat there. This bears out the matter of constituting an aerial shock force.

General reluctance to transform the aeronautical arm into a service is primarily responsible for the undeniable fact that aircraft have not thus far enabled any one belligerent to obtain marked superiority over the other. To achieve this it would seem necessary to raise the aerial arm from its subsidiary position into that of a full fledged service, possessing its own strategy, its own doctrine, an organization wholly independent of the senior services, and governed by an aerial general staff.

[Air Power—The Organization of Flying Troops. By Ladislas d'Orcy. *Air Service Jour.,* Apr, '18. 2800 words.]

The tactical unit of flying troops is the squadron. In the American and British Air Services the squadron consists of a headquarters, twelve machines, and a number of supply and repair trucks, trailers, despatch motorcycles, etc., which is determined by the character of the squadron. Squadrons are specialized in type according to function, and so there are reconnaissance squadrons, fighting squadrons, bombing squadrons, etc. In view of the considerable technical and tactical difference existing between various types of machines, there may be quite some variance between the effectives of a single-seater fighting squadron and of a twin-engined bombing squadron. Also, the rolling stock of the latter will be more considerable than that of a fast fighting squadron. Outside of these minor variations

the organization of an airplane squadron is as regular as that of an infantry company.

The squadron is subdivided into three flights of four machines each, the flight being the smallest tactical formation of the flying troops. In the daily routine of patrol work no smaller formation than a flight is normally used. As a flight may be detached for a short time from the squadron, it is permanently a self-contained unit, possessing its own personnel, transport, etc.

The organization of a German airplane squadron is closely patterned after the British tho it often differs in minor details. An enemy bombing squadron consists generally of twenty machines and is subdivided into four flights of five machines each.

In the French Flying Corps the squadron consists as a rule of six machines, and three squadrons form a group. In the British Service three or mores quadrons form a wing and three or more wings a brigade.

It is customary to equip each squadron with machines belonging to one type only. Mixed squadrons have been organized for reconnaissance work. Such squadrons might consist, for instance, of one flight of photography machines, of one flight of fire control machines, and of another flight of long range scouts. Or, a pursuit squadron might consist of one-seater and two-seater flights. The present tendency is to organize strictly monotype squadrons. The development of "all purpose" machines by the Germans, that is, airplanes which may be used for fire control, photography, tactical reconnaissance, short range bombing, and even fighting, is a further justification of the monotype squadron.

The officers and men constituting the personnel of the squadron subdivide into the navigating, the technical, and the administrative personnel. The navigating personnel comprises a number of pilots, observers, gunners, bombers, and radio operators corresponding to the strength of the squadron, while the technical and administrative personnel consists of a technical supply officer, and a number of air mechanics, fitters, riggers, chauffeurs, clerks, etc.

The flying troops in the field are subdivided, according to their respective functions, into several branches. Reconnaissance being the primary function of aircraft, it is natural that by far the greater part of the flying troops should be employed in reconnaissance work.

Contact patrol work consists in furnishing, between the advancing troop formations, a link whereby the headquarters staff is constantly informed about the progress of the advance. This work has proven of the greatest importance, because the barrage which the enemy lays down behind the advancing units makes the use of other means of communication extremely problematical. Infantry airplanes fly low to the ground in order to keep the best lookout on the progress of the advance. The enemy artillery cannot effectually attack them for fear of hitting his own troops; thus machine gun and rifle fire are the best, tho often ineffectual, means of countering the infantry airplane.

The success of contact patrol work eventually developed into the assaulting of troops and land organizations with machine gun fire. While this work was first considered in the nature of a sporting venture, the value of creating confusion in the enemy's ranks was soon realized and ground assault became a recognized branch of aerial warfare.

The German flying troops are divided into four sections. The first is the army flying section, the second the army corps flying section, the third consists of pursuit squadrons, and the fourth of bombing wings.

The army squadrons are principally employed for strategic reconnaissance. As the machines of these squadrons make extended flights on which the one-seater pursuit machine is not able to convoy them for lack of fuel, they carry strong defensive armament. A synchronized machine gun is generally carried forward and another on a gun ring aft. Often twin guns are mounted fore and aft. This is the typical two-seater fighting scout, which does not invite attack as its purpose is to observe, but which is able to defend itself and eventually force a combat in order to get back the needed information.

The machines of the army corps squadrons are very similar to the foregoing, but they are much smaller, and are chiefly employed for tactical reconnaissance, photography and fire control, but may be used for contact patrol work and ground assault. These machines operate within the zone of the army and carry as a rule a radio set when engaged in fire control. This may be replaced by a camera for photography work, or by a bomb gear for tactical bombing.

The pursuit squadrons are, as a rule, composed of single-seater fighters, and are used for the destruction of enemy machines and the protection of reconnaissance and bombing machines. The squadrons which are not formed into wings are assigned to army corps for the protection of army corps squadrons, and of cities behind the zone of the armies.

The battle wings consist of large bombing machines which carry, besides a considerable load of bombs, sufficient armament to successfully withstand the attack of pursuit machines. They are not as a rule assigned to an army or an army corps, but are under direct orders of the Great General Headquartes. The staff of the latter then assigns the battle wings to such sectors as may warrant a reinforcement of tactical bombing energy, tho as a rule the large bombers are employed against distant objectives. While the range of these machines is such that no pursuit plane could convoy them on their raids, their armament is generally powerful enough to keep their smaller, tho much swifter, antagonists at bay. Sometimes the enemy bombing wings are convoyed by powerful two seaters.

According to semi-official information gathered from the French, the number of Prussian, Saxon, Bavarian and Wurtemburg squadrons at present on war footing and at the front is 270, classed as follows:

100 army corps squadrons for tactical reconnaissance; 80 army squadrons, for strategic reconnaissance; 40 pursuit squadrons, for work at the front; 30 pursuit squadrons, for local protection; 23 bombing squadrons.

The total number of airplanes represented by these 270 squadrons is approximately 2500. The bombing and pursuit squadrons are being increased in number and strength very rapidly, as the German authorities

AERONAUTICS—Continued

consider them the most effective instruments of aerial warfare.

—Photography

See

PHOTOGRAPHY—AERONAUTICAL

—Propellers

[Theory and Operation of Dr. Zahm's Propeller Computer. By W. P. Loo. *Jour. Franklin Inst.*, Dec, '17. 1200 words. 4 figs.]

(An article with mathematical discussion unsuitable for condensation descriptive of a device for obtaining mechanically the data necessary for the design of airplane propellers. The construction and use, as well as the theory of the computer, are explained. The article will be of interest to those concerned with the design of airplanes and should be consulted in the original.)

[Finishing Up and Balancing Airplane Propellers. By Frank W. Caldwell. *Aviation*, Nov 1, '17. 1500 words. Illustrated.]

After the propeller has been roughed out it is desirable to let the wood season for a while before finishing. The present American practice is to allow only a few days for this seasoning. It is the opinion of the writer, however, that longer seasoning is desirable. By hanging the blades in a horizontal position a uniform circulation of air is maintained and the drying is done uniformly. After the seasoning is complete it is desirable to install the hub before any further work is done. The hubbing practice is at present very unsettled. The European practice is to allow one sixty-fourth of an inch oversize holes for the large center hole and for the bolt holes. In this case the whole drive must depend on the friction of the flanges. In American practice it has been considered desirable to make the hub flanges as small as possible in order to save weight.

A simple calculation will show what would happen in case the friction of the hub flanges were not great enough to drive the propeller and the bolts were fitted one sixty-fourth inch loose in the holes. Take the case of a direct drive eight-cylinder engine turning at 1400 r.p.m. There will be 4x1400=5600 pulsations per minute. Since the propeller is a flywheel it must absorb these pulsations. If the friction of the hub flanges is not great enough to drive, the flanges will slip at each pulsation until they come in contact with one side of the bolts and then slip back until they come in contact with the other side. The wood is soon burnished in a case like this. The writer has seen propellers charred and completely burned out of shape at the hub after ten or fifteen minutes in a case of this kind. The advantage of the American method lies in the saving of weight which is of foremost importance. Before installing the hub, four or five coats of linseed oil should be applied to the inside of the hub hole and bolt holes. The whole surface covered by the hub should then be coated with shellac. The propeller with the hub installed is now fastened in place on a lay-out plate.

Failure to track throws the propeller out of balance dynamically, but it is only shown up statically by measurement. After the blades are tracked it is necessary to align them so that a line passing thru two corresponding points on the trailing edges will pass thru the axis of revolution. The trailing edges are now used as reference lines, and the blade angles are worked down from these lines by means of a protractor or pitch card. The next operation is that of balancing. The propeller is balanced in two positions.

After balancing, the propeller must be sanded to a nice surface. Care must be taken to rub along the grain and never to let the paper rub across it. The propeller must now be given about four coats of linseed oil, balancing carefully after each coat. A nice finish may be obtained by rubbing with a mixture of linseed oil and shellac. It requires about three hours' rubbing properly to polish a propeller. To protect the tips of the blades from the abrasive action of sand and small stones and from spray in the case of a seaplane propeller, some form of sheathing is usually applied. In case copper is used for sheathing, the sheets should be carefully annealed before they are used. In case the blades are to be sheathed with linen they must be absolutely clean and no oil or other coating must be applied. The back side of the blade is coated with Scotch glue and the cloth is applied and rubbed down smooth. It is then ironed with an electric iron to improve the adhesion. The work must be done in a room at a temperature of 100 degrees. After the glue has set for about twenty-four hours, four coats of airplane dope may be applied, followed by two coats of battleship gray enamel.

—Reconnaissance by

See also

PHOTOGRAPHY, MILITARY

[Airmen or Cavalry. By "Oudeis." *Army & Navy Gazette*, June 22, '18. 1250 words.]

The uses of cavalry at the opening of the present war were well known, namely: reconnaissance, screening movements of their infantry, advance and rearguard work, raiding, pursuit work and charging a weakened enemy. The Royal Air Force, so recently formed may replace and supersede cavalry in the fulfilment of many of the duties formerly apportioned to this arm.

For obtaining information, the radius of action, speed, outlook and certainty of achievement of the airplane is far greater. Air formations will probably not be so effective in pursuit or rearguard work, but this function can be improved. For raids and like diversions the power of the airplane is much greater and a much larger force must be diverted by the enemy for protection of important points. The repose of troops may be easily disturbed by the bomber with little effort.

To provide for full functioning of the power of the air service, control of the air must be obtained just as the cavalry must first subdue the enemy cavalry to operate successfully. To get this control artillery support will be a great factor and the side which first

succeeds in furnishing their air service with full artillery support, either on the ground or in the air, will have obtained a distinct advantage.

There is a danger that the infantry and artillery may suffer from too great development of the air service. This is an error. We must have a just proportion of the various arms and the air service, like the cavalry, is accessory. To maintain two arms for the same service, however, is costly and it appears that, between the airplane and the cavalry, the latter seems likely to give place.

[Cavalry and the Aeroplane. By Major J. R. M. Taylor. *Infantry Jour.*, Aug, '18. 2500 words.]

This article is a reprint from the *Infantry Journal* of July, 1909, in which the writer very accurately described the increasing limitations of the cavalry. The European War has enabled the writer to see many of his prophecies realized, altho the airplane has greatly exceeded all his expectations.

—Seaplanes

[The Italian "Macchi" Fighting Flying Boat. *Aerial Age Weekly*, Dec 10, '17. 325 words. Illustrated.]

The Macchi single seater flying boat is one of the most efficient boats ever built. It is able to ascend 13,000 ft. in 18 min. The struts and interplane bracing employed is similar to that in the Nieuport scout. The overall dimensions of the machine are: Span, 39 ft.; length, 27 ft.; height, 10 ft. There is a lifting surface of 301 sq. ft. The loading per sq. ft. is 6.85 lbs. When empty the machine weighs 1510 lbs.; when fully loaded 2060. lbs.; total useful weight carried, 550 lbs. Near the surface the speed is 112 mi. per hr. The engine is an Isotta Fraschini 150 h.p. Sufficient gasoline and oil are carried for an air endurance of 3 hours.

[Austrian Ago and Lohner Flying Boats. *Aerial Age Weekly*, Dec 24, '17. 650 words. Illustrated.]

Two types of Austrian seaplanes which have fallen into the hands of the Italians during the present year and which are regarded as worthy of special note are the Ago and the Lohner. The struts of the Ago are of polished steel tubing with a fairing of laminated wood less than one mm. thick, providing a good stream line effect. The dimensions are: Span upper plane, 8m.; span lower plane, 7.38 m.; chord, 1.5 m.; length, 7.62 m.; motor, Warshalowiski, 218 h.p.; propeller, diameter, 2.72 m. The wing floats are spaced 5 m. apart. The tail group is 2.38 m. in span, sustained in front by a vertical fin of very thin, laminated wood, stays and wire cables holding it in place. The Lohner flying boat is an enlarged machine of the Lohner type retaining the V which is typical of that type. General dimensions are: Span upper plane, 9.7 m.; span lower plane, 7.2 m.; chord, 2.7 m.; hull length, 12.5 m.; bomb carrying capacity, 400 kg.; motor Austro Daimler, 300 h.p. The ailerons are trapezoidal in form, are 3.47 m. long and .9 m. wide. The body has two seats side by side and one in front, upon which is mounted a machine gun arranged to be movable and fired in any direction. The turret is armored.

[Seaplanes on Water. By Lt. G. L. Cabot, U.S.N.R.F. *Aviation*, Dec, '17. 2500 words. Illustrated.]

When on the water injury may result to seaplanes, first, from wave motion. Against this, the chief safeguard is movable ballast; men must be placed on that point on the machine which is most likely to rise. Second, from the wind. Against this the chief safeguard is the air controls. They are most powerful when most needed and as the wind whisks from side to side the air controls can be changed to meet it. When the air motion relative to the machine does not exceed 20 mi. per hr. the air controls have little power. When this motion exceeds 40 mi. per hr. the power of the air controls rapidly increases. When a machine is caught in a storm or seaway that threatens to overturn it and no help is near, it is best to anchor it by the bow and for this purpose a 30-lb. anchor and 100 ft. of rope should be carried. If the anchor will not reach the bottom it must be wrapped in cloth so that it will act as a drag and keep the nose of the machine in the wind. An automobile mirror in front of the pilot is a great help in flying and when on the water.

If a seaplane is to be towed any distance or is in danger of rain or snow, the air motor and the orifice to the Pitot tubes should be covered with waterproof coverings, so that they will not be wet by rain or spray. Salt water makes a rust that contains basic chloride of iron, which cannot be washed off and eats into the iron much faster than rust from fresh water. If water enters the Pitot tube, every trace of it must be removed, otherwise the air speed indicator becomes unreliable and death may result. The pilot should be in his seat and raise his elevator if the wind is in front, lower it if the wind is from behind. In a strong and heavy side wind, it will be helpful to send a man out on the windward wing to its tip. The men should always wear never-sink coats or life preservers, even tho good swimmers. When a tractor seaplane stands on its head it usually continues to float head downward. At high speed, you can hold the tail down by raising the elevator. If simply floating, there is no forward pull to increase the tendency to upset forward, but if you then start the engine, the forward pull and consequent tendency to overturn the machine at first exceeds the power of the elevator to counterbalance this tendency. In rising from the water it is first needful to raise the tail to a nearly level position by lowering the elevator; then the speed is increased until the machine rises on the water, then on the step and then leaves the water. Sometimes the machines will best leave the water without any further motion of the controls. Sometimes it is best to raise the elevator slightly to jump the machine out of the water and then level it off until it attains full flying speed. It is usually needful to warm the engine by proceeding under power over the water till the radiator shows over 100 degrees F. before going into the air, so that the lubricating oil will not be too stiff and the gasoline will ignite readily and develop its full power on explosion.

AERONAUTICS—Continued

Airplanes are exceedingly fragile and utmost care is repaid by more flying hours and less expense. The correct position in leaving the water is with a less angle of incidence than when resting on the water. In alighting on the water the position should be about the same as when resting. A slight change in the pontoons often makes all the difference between a crescendo in porpoising and a normal action. When flying for the first time a machine with which the pilot is unfamiliar, it is well for him to find out the balance of it before he takes it in the air. Each new machine given to an aviator is a new problem and if he doesn't realize this fact even a skillful and experienced aviator may come to grief.

—Seaplanes—Design of

[Seaplane Float Construction. By Charles G. MacGregor. *Aviation,* Jan 1, '18. 3200 words. Illustrated.]

Strains on the Float in a Seaway.—Longitudinal Strains.—When a seaplane passes from calm water into a seaway, the float or floats are subjected to certain strains due to the action of the waves. (1) Suppose the float is supported in the middle on a wave crest and the ends unsupported by being in a trough; the consequence is, the ends will tend to droop relatively to the middle. This bending of the float is termed "hogging." Under these circumstances the upper members of the structure of the float, such as the deck stringers, planking, etc., are in tension, and the lower members are in compression.

(2) Now let us consider the opposite extreme. As the waves travel along they reach a position where they support the two ends of the float, with the middle in the trough of the waves. Under these circumstances the lower members of the structure of the float, such as the keel, keelson, chine stringers, planking, etc., are in tension and the upper members are in compression.

Transverse Strains.—There are other strains tending to alter the transverse form of the float caused: (1) by the skidding of the seaplane on making a landing; (2) by the seaplane rolling heavily; and (3) by the float being buried under a wave. The forward end of the float is subjected to severe blows from the waves, which tend to force the planking inward. This bending is termed "panting" and is taken care of by special stiffening, either by stringers or by transverse floors.

The construction of these floats must from the very nature of their work be very strong, and most important of all, the lumber used must be of the very best that can be obtained, because each and every piece has to do its work almost to the limit of its strength. At the same time not a single ounce must be carried that is not absolutely required. Lumber with knots and sap is never used, and great care is taken to see that none of the material is checked or has a twisted grain. As there are two distinct forms of floats, it will be better to refer to them separately because of the differences in their construction. The flat side and flat deck float is known as a "flatback," and the rounded topside float is known as a "roundback." The principal difference in their construction is in the method of framing.

Keel Mould.—This is the first erection in the process of building, and tho not a part of the float it is nevertheless very important, as the whole hull is built on top of this and great accuracy is necessary in getting it correct at first, because any mistakes made at this stage of the building will prove to be very costly if discovered after the framing is well advanced. When a boat is being built the first part of the structure to be laid on the keel blocks is the keel. The function of the keel is to assist in the stiffening of the hull longitudinally. When the seaplane is resting on the beach or deck of a ship the weight of the whole machine is sometimes on the keel alone. One can, therefore, readily understand that this particular member must be very strong. The materials used in the keel construction are white oak, ash, Canadian rock elm and mahogany. The two former are the most suited to this work; they are strong and will stand steam bending very well. Elm is very troublesome to work and most difficult to keep in shape, it twists and warps so much. Mahogany is satisfactory for keels with easy curves where no steam bending is required.

Scarfs.—Before proceeding any further with the construction we will look into the manner of making these joints or scarfs most commonly used in float construction. Sometimes it is almost impossible to obtain certain lengths of lumber for planking or stringers; or it frequently happens that there is so much curvature in say a keelson, that to get it out of one piece would be well nigh impossible on account of the great width of board necessary, or on account of the cross grain at the ends. To overcome these difficulties it is necessary to make this particular part in two pieces. The joint of these two pieces is called a "scarf." The fastenings are copper tacks, rivets and burrs, and brass wood screws. The pieces are clamped and screw fastened and the ends and middle are strapped with light sheet copper. The heads of the nails securing the copper are soldered, to prevent working loose. In laminated construction the scarf is arranged irrespective of the grain. Care is taken to arrange the scarf or butt, so that it does not all come within one frame space.

Keelson.—The duty of this part is to assist the keel in stiffening the float longitudinally, and to strengthen the bottom to enable it to withstand the terrific impacts and pressure of the water. Where no keel is used, and the bottom planking runs across from chine to chine uninterruptedly, without any break at the centerline, the planking is screw fastened to the center keelson.

Floors.—The name given to this particular part of a boat is very confusing to one not familiar with boat or ship construction. These have nothing to do with decking or flooring directly, particularly so in the case of these floats. They are the cross frames or ribs of the bottom structure. Their duty is to assist the bulkheads in stiffening the bottom transversely. Each floor is made by either steam-bending it to form, or by cutting it out of a solid piece to the desired form.

Cap strips are sometimes fastened to the lower edge of the solid floors if made of pine or other soft wood. This prevents splitting or checking of the floor and makes something firm into which to screw the plank fastenings. The materials used in floor construction are oak, ash, mahogany, Spanish cedar, white pine, spruce, Port Orford cedar, and sometimes basswood.

Stem.—This part of a boat is generally a vertical member, but in most of the floats built in this country it is a distinct departure from this type.

Sternpost.—These are similar to the stems in construction and material. Oak knees are used to brace the corners. Occasionally a transom or flat board stern is used by some builders. An advantage claimed for the transom stern is that should the seaplane be afloat and drifting sternwards with the wind without having the sea anchor out, the water is not liable to climb aboard, and thus to tend to tip the machine over on its back.

Chine Stringers.—The chine is the name given to the sharp corner at the junction of the bottom and sides of the float. Along this edge a stringer is run to support the edges of the side and bottom planking. This is called the chine stringer, and is made in various forms.

—Seaplanes—Design and Construction

[Seaplane Float Construction. By Chas. G. MacGregor. *Aviation*, Jan 15, '18. 4220 words. Illustrated.]

(Continuation)

Deck Edge Stringers.—These are constructed similar to the chine stringers and are fitted to the deck edge of the flatbacks.

Body Molds.—Where bent frame construction is used, it is necessary to construct and erect temporary molds or forms to give the shape of the float. The fastenings used in the construction of the molds are wood screws (not wire nails), so that when the framework is completed they can be taken apart without breakage, removed from the interior of the framework and be reassembled for future use.

Deck Stringers.—All stringers which run inside the frames are bent over the ribbands, and riveted to the frames where possible. Where intercostal stringers, or stringers fitted in short lengths between the frames, are fitted, a ribband is let into the mold for this stringer to rest upon.

Fairing Ribbands.—When the molds are set up on the roundback type of construction, temporary ribbands or stringers are laid longitudinally outside of these spaced about 4 inches apart. Particular attention is paid to the "fairing" of the ribbands and the molds, so that there will be no bumps or hollows either transversely or longitudinally. The materials used are oak, ash, Oregon pine and yellow pine.

Frames.—These are of two types, viz., the steam bent and the solid frame. The former is used in the roundbacks and the latter on the flatbacks. The heels of all bent frames or ribs, as they are sometimes called, are strapped or shod with light sheet copper, so that the rivet or screw fastening thru the end will not split it. The nail heads in the copper are soldered so that they will not work loose and drop out. The built frames are made up in three parts, fitted to the inside of the planking all around, and where seam battens are used, a notch is cut in the outer edge into which these fit. The materials used for bent frames are ash, oak and elm; for solid frames, ash, oak, mahogany and Spanish cedar.

Bulkheads.—Floats are divided into watertight compartments by transverse bulkheads or partitions; each bulkhead is strong enough to withstand the pressure against it from one side should the water fill the compartment on the other side of it. Each bulkhead is built of two layers of wood with cloth and marine glue or varnish between them. The grain of each skin crosses the other at an angle of 90 degrees, and the skins are thru fastened with solid brass or copper rivets. Laminated wood under various trade names is used extensively for bulkheads, but unfortunately it is most difficult to obtain in this country. This wood is known as three-ply lamination or veneer.

Seam Strips.—The edges of all planks between the frames in the single skin construction must be supported in some way inside. The method adopted in float construction is by means of thin strips of hardwood run over the outside of the frames in a longitudinal direction, and placed so that each will come directly under the plank seam.

Doublings.—Where a hole is cut thru the deck or planking for handholes, struts or drain-plugs, this part is weakened thereby, and is reinforced by what are known as doublings or blocking made of hardwood. These are attached to the frames, stringers, etc., where possible.

Struts and Braces.—Here we have about the most difficult parts to construct in the whole float. This is a subject that is too extensive to enlarge upon in this article, because there are so many different methods of bracing or hanging the floats from the machine. In the use of steel struts inside, the point of attachment to the outer struts is kept as close as possible to the deck, and the inner struts as close up to the under side of the deck as possible, so that there is not too much length left unsupported between these points. On the flatbacks, where single struts are used, the struts are attached to the sides or to a cross bulkhead and are braced from there down to the keelson and chine stringers inside. The fitting of the interior float struts is one of the most difficult tasks undertaken by the float builder and it requires the most careful and skillful workmanship.

Planking.—There is a wide choice of methods of planking, but for good all around service, the double skin diagonal is the most serviceable and durable. Planks under 1/4 inch thick should never exceed 6 inches in width, and under 1/8 inch thick should never exceed 4 inches in width. When drilling holes for the fastenings in very thin planking a countersink is not necessary for the head of the fastening, as it draws in flush when it is riveted, particularly in the soft woods.

The following are brief descriptions of some of the methods of planking most commonly used and proved divided into groups for location, and are further sub-

AERONAUTICS—Continued

to be most satisfactory in actual service. These are divided into types, as follows.

Group 1. Topside Planking:

A. Single skin with seam strips.

B. Single skin with seam strips—fabric covered.

C. Double skin inner diagonal; outer fore and aft—fabric between.

D. Double skin inner diagonal; outer diagonally opposite—fabric between.

E. Three-ply laminated wood.

Group 2. Bottom Planking:

A. Single skin with seam strips.

B. Double skin inner skin diagonal; outer skin fore and aft—fabric between.

C. Double skin inner skin diagonal; outer skin diagonally opposite—fabric between.

D. Treble skin inner diagonal; intermediate diagonal-up opposite; outer fore and aft—fabric between all skins.

E. Three-ply laminated wood.

Group 3. Bulkheads.

A. Three-ply laminated wood.

B. Double skin, inner diagonal; outer diagonally opposite—fabric between.

Wood for Plaking.—The most common varieties are mahogany, white cedar, white pine, spruce, and Spanish cedar, when this latter is very carefully selected.

Fastenings.—For planking of the thickness used in these floats, the best fastenings are brass and copper rivets, in preference to wood screws; they hold better, can be driven in and have the ends turned over just as fast as a screw can be driven, and will not loosen up so readily. The rivets are known as Canoe rivets, varying in length from 3/8 inch upward.

Fin Construction.—Fins are sometimes required in some floats for stability or additional planing surface. The construction of these is very simple. Capstrips as used on the floors abreast the fins are extended out past the float side the required distance. The outer ends are notched into the fin edge stringer, which is usually made of ash, and the fin frames are also notched into the stringer at their lower ends, with the upper ends attached to the stringer at the float side.

Fabric Covering.—The material used for the covering of floats either between the layer of planking or on the outside of the planking must be very strong, light but not too thin, with sufficient body in it to hold the varnish or marine glue with which it is saturated when being applied. Linen covering used on wings has been tried and found to be very suitable for the lighter types of floats, such as scout machines; but it requires proper and careful handling. The fabric is stretched in one piece wherever possible, with plenty of allowance along the edges and on the ends for gripping by hand when stretching it over the float. Before the fabric is stretched over, the float is given another coat of glue, sparingly but thoroly applied over the first. This and the stretching are done very rapidly, as the fabric must be in place before the glue sets and hardens. The glue is allowed to dry thoroly for two or three days in the same room before painting over. Three coats of paint are sufficient for the outside, the first one being thinner than the remainder.

When varnish is used instead of the glue, practically the same process is gone thru, with the exception that the first coat is applied to the bare planking just before the fabric is stretched over. When the fabric is used between the skins of the double planking the same general method is followed. The fabric in this case is not stretched so tightly as the outside covering, and is tacked here and there to the inner planking to hold it in place while the outer skin is being built over. If it is found necessary to make a seam, the lap is arranged so that the edge of the fabric in a transverse seam does not face forward on the outside. The after edge of the foremost piece laps over the foremost edge of the after piece.

[Seaplane Float Construction (3rd installmént). By Charles G. MacGregor. *Aviation*, Feb 1, '18. 1500 words; illustrated.]

Step Construction.—After the topside planking is complete, the boat is loosened from the mold, lifted off, turned completely over, and is set upon a padded mold for the completion of the step and bottom planking. The step floor is built very strong, and is rabbeted to take the stern bottom planking, and the inner skin of the bow bottom planking. A bulkhead is arranged so that it will come at the step, in order to stiffen the float at this particular part.

False Keel.—To protect the bottom planking from wear and tear, a false keel is fastened on outside the planking, usually extending from about two feet from the stem to the after end of the skeg in the step float, and right back to the sternpost in the stepless float. The materials used in their construction are ash, oak, elm, mahogany and yellow pine.

Spray Strips.—These strips are fitted along the chines on the underside, so as to deflect downwards the spray that is thrown out from the bottom when the seaplane is taxi-ing, so that the spray will not catch on the propeller.

Skeg.—This is fitted at the back of the step in line with the keel. It is made of pine, ash, oak or mahogany.

Air Tubes.—These are fitted usually behind the step, and extend from the deck down to the bottom planking. Their purpose is to admit air down to the back of the step to break the suction of the water on the bottom when the seaplane is running at planing speed, and so enable the machine to get off the water. They are built of sheet steel or copper.

Drain Plugs.—Each watertight compartment has a drain plug at its lowest point, thru which all the water can be drained. Another method of extracting the water from the interior of the float is by means of copper piping, led from the lowest point of each compartment to a deckplate where the ends of all the pipes project thru about 1½ inches. A small portable pump is used with a short length of rubber hose which is slipped over the pipe ends at the deck.

Towing Cleat.—There are several methods of towing a seaplane, such as from the bow towing ring; from the deck cleat or from the struts. The towing hawser in the first method is belayed to a U-bolt or ring

bolted to the stem. Another method is the most commonly used. The towing hawser is rove thru a closed chock bolted to the stem and is then belayed to the cleat on the bow deck, which is bolted thru the deck to the interior bracing. The machine is steadied by leading the hawser thru the closed bow chock.

Handholes.—Access to the interior of the float at each watertight compartment is obtained thru handholes fitted to the deck, so that it may be ventilated, examined or repaired.

Painting and Varnishing.—Before the bottom planking is put on finally, the inside of the float and the inside of the planking are given three coats of varnish. The outside is given at least three coats of paint, each coat being well sanded before the next one is applied. These floats are very delicate and light in their construction; therefore, the greatest care is taken in moving them around. If they are stored or left outside exposed to the rays of the sun, they are covered with a damp sheet to prevent the wood from drying out and checking.

—Tactics

[Italy's War in the Air. *Independent,* Dec 22, '17. 215 words.]

The desperate struggle on the Italian battle front was marked on Dec 8 with what is described as the most formidable aerial "drive" yet seen in the war, and one which gave portentous earnest of what may be done when the thousands of airplanes which are now being constructed in this country are placed in action. A fleet of one hundred and fifty Italian airplanes swept over the Teutonic lines, dropping bombs by the thousand, and pouring from machine guns mounted on the monster Caproni planes a torrent of shot upon the hostile troops. As the vessels sailed at only a short distance above the earth, their aim was accurate and the destruction wrought was enormous. It is stated that whole batteries were demolished, fortifications were destroyed, stores of ammunition were blown up, troop trains were scattered, motor truck columns were disorganized and railroad and supply depots were reduced to ruins. This raid was made in daytime and was repeated at night; at the latter time four tons of bombs being dropped upon the Teutonic lines. The Italians appear to have a decided superiority over their foes in aerial warfare, and their exercise of it contributes largely to their success in holding back the invaders at the line of the Piave.

[Aircraft in Defense. *Canadian Military Gazette,* Apr 23, '18. 95 words]

The possibilities of aircraft in defense have been considerably developed in the present battle in France. The machine-gunning of troops on the ground and the bombing of railheads, junctions, etc., have been carried farther than ever before. Some general conclusions reached by observation and questioning of prisoners are:

Low-flying aircraft cannot be dealt with by other aircraft. They have to be dealt with by infantry or artillery from the ground. An infantry attack cannot be held up by airplanes however numerous, but its impetus can be reduced to a certain extent.

[Formation Flying. By Dean Ivan Lamb. *Air Service Jour,* June, '18. 1200 words.]

Flying in formation has taken the place of single combat, as the Germans seldom fly singly, but in groups of four or more, and will attack only smaller formations.

When flying in correct formation, the chances of being brought down by anti-aircraft fire are much smaller as the gunners seldom concentrate their fire on a single machine, and also because the machines keep at different levels.

The "V" formation is commonly used. When attacked from the air all machines can fire at hostile machines above or below without changing position and are in position to attack hostile formations.

This formation is used in reconnaissance, bombing raids, defensive and offensive patrols. In bombing raids the formation is kept until about two or three miles from the place to be bombed, then the machines fall into single file and drop bombs as they pass over the target. In actual practice the whole formation zigzags over the lines at various speeds and each pilot drops his bombs when he thinks that they may hit the target. If all machines flew straight over the target the "Archies" would be almost certain to get the last few machines.

When in formation in offensive patrol, all machines take a zigzag course in unison and make all attacks without leaving the formation.

Defensive patrol is also carried out in formation, except on our own side of the lines, where the formation patrols in a straight line. Reconnaissance is carried out only at such altitudes that there is little fear from "Archies" and only defensive combats occur. These seldom break a formation.

When two or more machines attack another, they may dive from different directions and bring down the enemy machine before the pilot of the latter can decide which machine to fire at.

A formation of machines is more effective in breaking up infantry formations than a battery of artillery and is only brought down by chance shots. Anti-aircraft guns are useless against machines flying at very low altitudes and infantry can not be taught to fire ahead of a machine which is making an attack.

Three formations usually go on long daylight bomb raids, one above the other—the bombers in the lower formation, protected by the battle (or reconnaissance) planes about 1000 feet above and the scout (pursuit) machines 1000 feet above the fighters and slightly ahead.

It takes months of practice to fly in good formation when in action. Five machines flying in formation are as effective as ten machines flying singly and are not in so much danger of "Archies." Owing to their number they are not so liable to attack, and the element of a surprise attack is almost wholly negligible.

Each machine in the formation is numbered and No. 1 machine attacks the first machine to land in an airdrome attack, No. 2 the second, etc. Then the bomb-

AERONAUTICS—Continued

ers come over flying very low and destroy anything that the scouts have missed.

Formation flying cannot be practised too much as it is fast becoming the accepted practice of battle, bombing and reconnaissance work. It is to be expected that before long airplanes will be crossing the lines in formation just as infantry goes over the top, and that the individual air work eventually will be entirely abandoned.

—Tactics—Co-operation with Infantry

[The Airplane in Co-operation with Infantry. Crónica. *Memorial de Artillería*, Dec, '17. 400 words.]

This co-operation started several months ago when an Allied aviator, seeing German re-enforcements moving up to the front line trenches, descended rapidly to 20 or 30 meters above the German column and opened a deadly machine gun fire upon it. The Germans were taken entirely by surprise, and were not able to repel this new form of attack.

What was at first merely an incident of airplane reconnaissance has developed into a new form of battle in which the airplanes help the infantry assault by machine gun fire and bomb dropping.

During one of the latest British offensives twenty airplanes took part in the attack, firing about 28,000 rounds in all. These machines were protected from German aircraft by friendly squadrons at a greater altitude.

The airplane for this sort of work must be of the lightest, fastest single-seat type. Its sole defense against enemy fire is speed and maneuvering capacity. It must be armed with a single machine gun mounted to fire thru the propeller.

During the attack, the aviator must come down to 30 meters from his target, pass above it at full speed with his machine gun firing at a maximum rate and immediately climb out of range.

—Tactics—Squadron Formation

[Formation Flying. By F. W. Lanchester. *Air Service Jour.*, Aug 16, '17. 2200 words. Illustrated.]

Formation flying, in brief, means that an air squadron or combined air squadrons, instead of flying as individual airplanes, each bent on the object in view but under separate command, fly in definite prearranged formation or pattern, in which, in naval phraseology, the machines have orders to "keep station." In the early days of the war we heard little or nothing of formation flying; in fact, it is only during the last twelve months that the practice has become common, and in certain directions general. The adoption of formation flying amongst birds is consequent on the fact that it leads to economy in power; in other words, that flying in V formation saves labor on the part of the bird, enabling it to get over the ground with less work. Formation flying is mainly confined to birds of considerable flight speed, corresponding to the conditions of heavy loading; that is to say, the birds which fly in formation are commonly those in which the supporting area, and particularly the wing span, is small in proportion to the weight of the bird. Military necessity requires that each ultimate unit of any force shall be combined with its fellows in such a manner as to impart the greatest fighting value to the force as a whole. In the air the single machine or airplane is the unit, and a concourse of machines flying without formation, even tho acting for a definite purpose, is little more than a mob when it comes to aerial combat.

The "N-Square Law" means briefly that if, for example, only five machines were flying in sufficiently close formation to act in attack or defense simultaneously—that is to say, so that the enemy could not approach one without coming under fire of all—they (in formation) would be more than a match for any force of machines (of equal individual fighting value) that might attack singly up to the number of twenty-five. In the case in point doubtless an individual machine could attack a formation of five without coming equally under the fire of the whole formation; beyond this the single machine has a freedom of maneuver which a formation has not, and could never have. However these facts can only modify and never destroy the advantage derived from concentration, and in the future of air warfare formations must be met by formations, just as in naval warfare cruiser squadron meets cruiser squadron or battle fleet, and victory is to the strong. The size of the formation engaged in aerial combat will in future depend very greatly upon the weapons and the range which it is found practicable to employ when airplane attacks airplane.

In order that the air fleet shall be brought into action as a single unit it is not only necessary that it should be homogenous in its constitution, but it must also be handled in some definite formation. Where the numbers are moderate as, for example, in the handling of a single squadron, the formation adopted may evidently be fairly elastic, and there will be no difficulty in bringing the tail of the formation promptly into action. When the numbers become great a point will inevitably be reached when the accuracy and closeness of the formation will be a matter of first importance to the tactical scheme, since the only way in which the whole force can be brought to bear at once will be by a studied plan, in which each machine will have its allotted place. One of the difficulties which exist to-day, and probably will always be a matter of anxiety, is that of signalling; and to whatever extent this remains a difficulty, the flexibility of the formation will be impaired. In order to render it possible to control large numbers, it would appear to be evident that the unit command will be a small group, or what is at present termed a "flight," some four or five machines strong, and that the individual machines will act on the plan of follow-my-leader.

It has long been observed that certain birds, flying numbers strong, as in migration, are in the habit of assuming definite formation, and that this formation is of the shape of a letter V, traveling point first. The reason for this is almost certainly one of aerodynamics; the air immediately in the wake of a bird in flight has residuary downward motion, and so is *bad* air from the point of view of the bird following. On the other

hand, the air to the right and left of the leader has residuary upward motion, owing to the vertical character of the wake disturbance, and so is *good* air. Consequently the V formation arises naturally from each bird seeking the air which gives the best support, a matter in which most birds show consummate skill.

—Theory of

See also

Aeronautics—Design of airplanes

—Use of in European War

[Twenty-eight Different Uses for Aircraft. By Henry Woodhouse. *National Service,* Dec, '17. 1500 words.]

The popular notion is that an aviator's duty is either scouting, fighting or dropping bombs. As a matter of fact the aviator's duties increase in number and importance every day. Aviators and balloon pilots are already employed to perform twenty-eight different duties. In connection with the military operations the following services are rendered:

(1) Bombing the enemy's bases, destroying railroads, trains and material.

(2) Fighting hostile airplanes, preventing them from reconnoitering, etc.

(3) Photographing the enemy's positions.

(4) Reconnoitering, determining the strength and dispositions of the enemy, as well as his probable intentions.

(5) Directing artillery fire.

(6) Contact patrol—co-ordinating the activities of the different arms during an attack.

(7) Co-operating with the infantry in taking trenches by flying low and attacking the enemy with machine guns.

(8) Co-operating with the artillery by attacking the personnel of hostile batteries with machine guns.

(9) Making attacks with bombs or guns against land forces to engage the enemy and distract his attention from operations which are about to be conducted.

(10) Conducting aerial attacks against enemy forces to relieve the pressure being brought to bear by the enemy against one's own lines.

(11) Preventing the arrival of reinforcements by bombing troops in trains or on the march.

In connection with the navies aircraft have been used for the following:

(1) Attacking ships and submarines at sea.

(2) Bombing the enemy's bases and stations.

(3) Attacking the enemy's aerial scouts.

(4) Scouting for fleets at sea.

(5) Defending and protecting naval bases and stations against naval or aerial attacks.

(6) Protecting ships at sea and in ports against attacks from hostile submarines and battleships.

(7) Convoying troop ships and merchant vessels on coastwise trips.

(8) Patrolling the coasts, conducting doubtful ships to examining stations and watching the coasts for submarine bases.

(9) Preventing hostile aircraft from locating the fleet and from getting information about its dispositions.

(10) Locating and assisting in the capture or destruction of hostile submarines.

(11) Guiding submarines in attacks on ships.

(12) Locating mine fields and assisting in their destruction.

(13) Expediting mine planting by serving as the "eyes" of the planters.

(14) Spotting for the battleships.

(15) Acting as messengers for important messages which could not be entrusted to the wireless for fear they would be picked up by the enemy.

(16) Carrying out diversions to mislead the enemy while the fleet was engaged in important maneuvers.

(17) Securing photographs showing strength and dispositions of the hostile fleet and condition of their bases.

[Air Power—Aircraft Troops as an Arm. By Ladislas d'Orcy. *Air Service Jour.,* Mar, '18. 2600 words.]

The primary function of aircraft troops, organized as an arm, is reconnaissance, be it tactical or strategic. Fire control is simply a branch of this function, while fighting is purely accessory to it. Bombing is, on the other hand, in a place all by itself, and constitutes the secondary function of the aerial arm.

For reconnaissance duty, two types of machine are available according to the purpose in view. For tactical reconnaissance there is the short-range scout, operating on a radius of not more than 25 or 30 miles, and for strategic reconnaissance, the long-range scout, which operates up to 100 or 120 miles. For a special mission involving a flight of long duration into enemy country this range may possibly be doubled. In such case, two-seaters are generally used as single seaters, the load capacity gained by leaving the observer behind being made use of to carry a larger supply of fuel.

Reconnaissance by means of aircraft, and in particular by airplanes, is to-day an absolutely indispensable aid to military operations, particularly so since the airplane camera has enabled the aerial observer to automatically record the result of his observations. With the old methods of mapping mistakes were always possible but the camera's record is clear and discloses the minutest details which might otherwise escape the attention of the observer.

In the early days of the war, the entire materiel of the belligerent aircraft troops was used for making reconnaissance flights. Gauged by present numbers, machines were scarce, and it was natural that military leaders should exact the utmost of them for the purpose of learning the enemy's intentions. Gauged by present achievements, airplane performances were poor, so that in order to get a suitable range of action for reconnaissance, the disposable load was all crew and fuel. Armament, besides a revolver, or an automatic, was not carried, because it would have reduced the flight range, and also because it might have brought about fighting in the air. This was deemed inadvisable as

AERONAUTICS—Continued

the primary function of the airplane was, and still is, the obtaining and bringing back of information. The hazards of air fighting would naturally have involved losses of machines and pilots and of the much-needed information, which it was impossible to gain by other means.

As the matériel and personnel of the aircraft troops increased, it became apparent that reconnaissance, pure and simple, did not entirely satisfy the demands of military science. As each belligerent was able to observe behind the enemy's lines, aircraft would simply neutralize every action of the opponents. and thus bring about a deadlock. This consideration induced the belligerents to mount a machine gun on the reconnaissance machines, and aerial combats promptly ensued.

The advantâge of superior speed is obvious; and the importance of a quick climb becomes self-explanatory when it is realized that an upper berth—which is first occupied by the quickest climber—gives the aviator the possibility of imposing his will upon the adversary; that is, the choice of the moment to open combat. To this moral advantage must be added the tactical advantage of keeping the enemy under one's own fire while the latter has to climb into a fighting berth.

Notwithstanding the tremendous development of air fighting and the consequent specialization of machines for this purpose, the primary function of the airplane has remained what it originally was—reconnaissance. Fighting never brought about a decision, altho it is quite conceivable that it eventually might do so.

Bombing is the secondary function of aircraft troops, and curiously enough there is little apparent correlation between this function and aircraft reconnaissance. Bombing machines may be likened to long range artillery in that they drop high explosives on a given target. The target may be a hundred miles away instead of ten, and the effect produced is less certain, but the purpose is the same.

The bombing of aerodromes, ammunition dumps, etc., has undeniable military value because it tends to reduce the fighting strength of the enemy but one fails to see why the bombing machines should be assigned to the aircraft troops rather than to the artillery, since the action of the bombarding branch is no more related to the primary function of aircraft than is the artillery.

The large bomb-carriers generally mount three or more machine guns, which afford them a means of defense against such opposition as they might encounter in the pursuit of their duties within enemy territory. All nations station their best fighting machines in front for the protection of their reconnaissance airplanes. It follows that in the zone of the interior such fighting machines as are available are not of the latest type. To tackle these the armament carried by the large bombers generally proves up to expectation. However, when the bombing party crosses the firing lines it may be attacked by the best fighting scouts of the enemy, and as the bombers carry heavy loads of explosives, and are besides constructionally sluggish, they would fall an easy prey to the fighters were they not convoyed by machines of the latter class.

The bombing branch of the aircraft troops, as at present organized, furnishes a striking example of concentration. Here one has the embryo of an aerial shock force, a force which not only would go into action against the land establishments of the enemy aircraft troops, but also against the latter's flying matériel. If concentration is right in the case of bombing machines, it surely cannot be wrong in the case of fighting machines. But to achieve this it would be necessary to set up the aerial shock force as an organism distinct from the aerial arm.

[Progress in Aeronautics. By Major H. Bannerman-Phillips. *United Service Mag.* June, '18. 3300 words]

Altho the airmen of the western front are much more prominent in the public eye, the airmen who have taken part in the campaigns in Mesopotamia, at the Dardanelles, and in Palestine have every reason to be proud of their achievements. Tremendous difficulties have been overcome, and the work has been one long test of courage, endurance, and efficiency.

Prominent among the duties has, as always, been the work of strategical and tactical reconnaissance. In Palestine. more than elsewhere, aerial photographs have been relied upon for topographical information. Maps prepared many years ago for the Palestine Exploration Fund were found to be remarkably accurate. By the help of aerial photographs these were brought up to date much more rapidly than could have been done by survey parties at ground level, and many areas inaccessible to the latter were covered and registered with astonishing accuracy by aerial photographers.

The dominance of the Allied airmen on the western front shows plainly in the figures. In March, 1059 airplanes were brought down all told on all fronts. The next highest monthly total was in September, 1917, with a total of 704. April, 1918, shows a total of 470 enemy machines claimed as destroyed, as against enemy claims of 113 Allied machines destroyed. (Details of individual day reports follow. On March 24 the British airmen destroyed 45 machines, drove down 22 out of control, and two were shot down by the gunners. The best day's total in April was 40 destroyed, 20 driven down out of control, and two shot down by anti-aircraft artillery.) Since November, 1917, British airmen in Italy have destroyed 101 enemy machines and have lost only 10 missing, a remarkable record.

Controversies concerning changes in the Air Ministry and Council are much to be regretted. The problem of handling the Air Service had become too complicated for dual control. From the reorganization there may be hoped complete co-ordination of effort by the time the aerial resources of the United States have been developed.

A statement of the United States Secretary of War shows that early in May there were over 500,000 American troops in France. The military authorities of the United States have made adequate preparation for a war lasting several years.

The American government did not hesitate to commit itself to one of the most ambitious of industrial experiments—the quantity production of an American-designed aero-engine. No nation is as yet equipped for such a task. Our airmen must be furnished with

the best and most reliable airplanes, and the most important adjunct is a well-designed, up-to-date, highly-finished engine. The technical difficulties of producing a constant and increasing supply of machines are not sufficiently realized.

The science of aeronautics is in a state of rapid development. Improvements are constant. It takes more than a year from the conception of the design of an aero-engine to the delivery of the first engine. The corresponding period for the airplane itself is half that time. Plans have to be made long in advance, and may be upset by uncertain factors. Machines do not always live up to early promises. Every new type is more or less of a gamble. Meanwhile the output of machines must be maintained.

The rate of wastage of machines, spares, and accessories varies, and yet changes in design or quantity introduces disorganization.

Maximum output requires concentration on a single type of engine as the American Government has done, or at least to reduce the types to a minimum number. Standardization is desirable but very difficult of attainment.

The development of the present British Air Service from the three squadrons of the Royal Flying Corps that crossed the Channel with the British Expeditionary Force in 1914 has required, in addition to skillful organization, the most intense effort upon the part of the manufacturers and industrial workers of Great Britain, involving numerous trades and employments.

[Progress in Aeronautics. By Major H. Bannerman-Phillips. *United Service Mag.*, May, '18. 3300 words.]

The work of our (Allied) airplanes during the German offensive beginning Mar 21 has been beyond all praise. A total of 339 hostile airplanes was brought down during the first phase of the operations. On one day 69 enemy airplanes were accounted for, of which 47 were absolutely destroyed. Much work was also done of tactical nature against troops and enemy works near the lines, and of strategical nature against important centers behind the lines.

The systematic co-operation of large numbers of airplanes in attacking enemy infantry has become an important feature of modern battle. The Allied airmen are particularly fitted by temperament for this class of work.

The monthly summary of air casualties gives proof of the skill of the Allied airmen. During the month of March, 137 British machines were reported as "missing," against 372 German machines destroyed and 205 driven down. The French airmen have likewise distinguished themselves by valuable service during the present offensive. General Plumer reports from Italy brilliant services of the British airmen there. During their stay in Italy they destroyed 64 hostile machines (mostly German); the British losses were 12 machines and 3 balloons.

Our airmen should be fully supplied with machines and equipment. Our designers are the best in the world, but our manufacturing resources have not been fully utilized. Better results may be hoped for under the recently instituted Air Ministry.

We have a better choice of candidates for our flying service than the enemy, but he has the advantage of training grounds and in weather conditions.

Standardization of engines and parts will do much to increase airplane production, but it has taken nearly four years to gain the knowledge which makes standardization advantageous. Airplane engines cannot be standardized with the same facility as automobile engines. In the latter weight is not of vital importance, but cost is. In the airplane engine weight is of vital importance, but cost is secondary to the necessity of the best and most reliable engine obtainable.

The automobile engine is not subject to the severe duty of an airplane engine. The former rarely works at full power and then only for short periods, while the latter works practically continuously at full power when in use. The lubrication of an airplane engine is most difficult and complicated, due to the high mean effective pressure incident to continuous work at full power. Thus the problems of airplane engine design are much more difficult than those of automobile engines. Additional requirements of the airplane engine are simplicity in design and handling to facilitate rapid training of airmen, ready accessibility so that parts damaged in use may be quickly replaced, and conformity to the stream-lined shape of the airplane body. There are also limits in over-all length and size, and the head resistance must be taken into account.

Airplane design has undergone notable changes due to the various duties required of the machines. Duties of reconnaissance, photography, and bombing meet with determined resistance, and the combined effect of improvements in aerial tactics and in anti-aircraft gunnery has raised the average altitude of aerial work from an average of about 5000 feet to an average of about 16,000 feet. High altitudes affect the problems of carburation, engine compression and cooling.

Thus there is continual change in airplane design, but the life of an airplane in use is short and this fact offers the opportunity to introduce changes in the replacements necessary.

At present the energy of the Air Council is devoted to the production of airplanes for war use. Upon demobilization there must of necessity be a great curtailment of production. Plans should be made now for the utilization of the knowledge gained in aircraft design for commercial purposes after the war.

[War in the Air. By "Aeronautics." *Army & Navy Gazette*, June 22, '18. 850 words.]

On the 12th, the American air forces commenced independent raids by bombing the railway station of Dommary-Baroncourt and, on the 13th, the station and tracks at Conflans. The bombardment of enemy lines of communications is of immense importance during the present German offensive in France. Out of the 55 raids of British airmen in May, the important railroad centers of Thionville and Metz-Sablons were satisfactorily bombed on several occasions.

Two Italian pilots recently flew to Friedrichshafen, photographing the place and returning after a journey of 500 miles. The record distance for a flight is that of Lt. Marchal, a French airman who flew over Berlin

AERONAUTICS—Continued

two years ago trying to reach Russia. He covered over 800 miles but engine trouble forced him to land and he was captured. In September, 1916, Capt. Beauchamps, French, dropped bombs in Essen. This feat was duplicated by Sgt. Gallois in July, 1917.

Up to the present the Americans have flown airplanes of European design and manufacture, as the tonnage required for transportation of American machines can be more profitably used for supplies, etc. Their machines have been used for training. It will be found that methods of quantity production based on standardization of design will not hold water, as designs of airplanes are constantly changing under the stimulus of experience and the necessity to go one better than the enemy.

The first public reference to an independent air force (by junction of the naval and military air services) was made in a *communiqué* from the Air Ministry on the 17th. The railroad stations and sidings of Thionville were attacked by this force four times from the 6th to 11th. Several direct hits were observed on the station, and an explosion was seen to take place near the Carlshütte works. At Metz-Sablons, which was twice attacked, a train was wrecked by a direct hit. Six tons of bombs were dropped and machine guns were used at low altitudes. Some 3½ tons of bombs were dropped, with good results, on the railroad sidings at Karthaus and on the railroad and ammunition factories at Hagendingen and Dillingen. No machines were lost.

Enemy airmen have been unusually active on the northern portion of the British front and French battle zone. On June 17 eleven hostile machines were destroyed by us in air fighting and nine driven down out of control, one German balloon was brought down in flames. In addition one hostile machine was shot down and another driven down out of control by our anti-aircraft fire. We lost 10 machines during the day, six of which were working south of Montdidier. The unusually high percentage of losses points to strong efforts of the enemy to dispute our control of the air.

AIRCRAFT

See
AERONAUTICS

AFRICA

See also
EUROPEAN WAR—GENERAL NOTES ON OPERATIONS BY THEATERS—AFRICAN THEATER

AGO BIPLANE

[The German Ago Fighting Biplane. *Aerial Age Weekly*, Jan 14, '18. 3240 words; illustrated.]

The first impression one receives on being suddenly confronted with the captured Ago biplane is apt to be one in which surprise mingles with curiosity. As regards its general lines, the Ago is of a strikingly unusual appearance, mainly, no doubt, due to the fact that its wings are tapered very pronouncedly from root to tip. In the first place, it is obvious that whatever it was the designer was aiming at, he was prepared to go to considerable trouble to obtain it since the construction of such tapered wings is not by any means an attractive proposition commercially, entailing, as it does, the separate construction of half the ribs, no two of which are alike from root to tip on one wing. Also as the spars converge to a point at the tip, they intersect the ribs at varying distances from root to tip, which again means extra work in manufacture. As for the spars themselves, they also taper from root to tip, again more trouble and expense. When standing in front of the machine one is at once struck with the pecular bracing of the front spar. Instead of the usual interplane strut, there is on the Ago only a single solid wire running from the front lower spar to the front top spar, while no lift or landing cables of any sort are employed between the two front spars. By doing away with the front bracing, a much freer field of fire is obtained, and there can be little doubt that this was the object for which the designer was striving.

The narrower chord near the tip will result in a smaller travel of the center of pressure, hence possibly the twist on the wings may become less, and the absence of front bracing be a less serious defect than one is inclined to imagine at first.

As is well known in biplanes, with top and bottom planes of the same area, and with conventional spacing of gap about equal to chord, the top plane carries about 30 per cent more load than the bottom one; by running a wire from the top to the bottom front spar, the latter is therefore made to carry a certain share of the spar's load, thus relieving the enormous bending moment that must be present on a comparatively heavily loaded machine, whose front spars have a distance of some 13 feet 6 inches between supports.

In section the fuselage is rectangular, a light and comparatively flat structure forming a turtle back over the top of the main fuselage framework. This turtle back is built up as a separate unit, and is easily detachable by means of a neat and very simple clip. In case of severe stresses being put on the fuselage, it is therefore a very easy matter to detach the top covering and examine and adjust the internal bracing. The four longerons, which are of square section, are pine, from the rear cockpit to the stern, while in front they are made of ash. The struts are in the form of steel tubes, and the solid wire bracing is attached to the struts. Except for the fact that the longerons are pierced by two holes—the horizontal and vertical fuselage struts are staggered in relation to one another—close to one another, this arrangement appears to be very neat, and certainly takes up very little space. The rear cockpit is occupied by the machine gunner, who is seated on a small seat built up of a framework of steel tubing, over which is stretched canvas. This seat is so hinged and sprung that immediately the gunner stands up the seat springs into a vertical position out of his way in case he wishes to do his shooting in a standing position.

The gun is mounted on a swiveling bracket, which in turn is supported on a rotatable gun ring of wood, forming, in effect, a turntable, by means of which the

gun may be traversed in any desired direction. To prevent damaging the nose of the machine and propeller, a stop is provided for the gun in the form of two small frames clipped to the rear legs of the cabane, which prevents the gun barrel from traveling too far inboard. The pilot's seat, which is in the front cockpit, is placed on top of the main petrol tank resting on the floor of the fuselage. A service petrol tank is carried in and mounted flush with the top plane just to the left of the cabane. In the corresponding opening in the upper right hand wing is carried the radiator, and in connection with these two it is interesting to note that the petrol and water are led thru the right and left legs of the cabane.

The large engine—230 h.p. Benz—is mounted on two longitudinal bearers which are in turn supported from the fuselage by three direct supports—at the rear by a sloping panel of ply wood, at the center by tubes sloping up from the lower longeron and at the rear by a vertical ply wood panel. The oil tank is carried under the engine housing on the right hand side of the crank case. The ribs are of the usual I section—the webs of poplar and the flanges of ash. The leading edge is of pine of a rounded V section. The trailing edge is a thin lath about 1 inch wide and 3-16 in. thick. The spars are constructed of Dantzig pine. The spars are strengthened by a peculiar metal fitting where the drift-wires to the top plane are attached. The ailerons are hinged to a false spar slightly to the rear of the main spar. Each aileron is mounted on and moves with the tail plane. It is therefore impossible to get a great amount of adjustment, as comparatively small movement of the tail plane rear spar brings the rudder against the cut out portion of the fin.

AIRCRAFT

See

AERONAUTICS

AIRPLANES

See

AERONAUTICS

ALBATROS BIPLANE

[Description of the Austrian Albatros Biplane, Hansa-Brandenburg Type, 200 H.P. Warchalowski Engine. *Aviation,* Nov 1, '17. 1475 words.]

The enemy airplane described, which was captured almost intact in 1917, does not differ sensibly from those of the same type in use since the beginning of the war. It shows no substantial improvements, except slight changes with regard to the position of the radiator, the housing of the engine, the tail planes, etc. The Hansa-Brandenburg type, judging from the pitch of the propeller, cannot exceed 155 km. per hr. Judging from the speed and the gasoline supply the machine cannot make a trip over 550 km. The pilot and gunner are slightly protected from below by a thin armor on their seats. The center of gravity moves about considerably longitudinally owing to the fact that the gasoline tank which serves as a seat for the pilot is situated far behind the center of gravity of the machine. The center of resistance is high with respect to the axis of thrust. If the machine is pulled sharply out of a steep dive, which has raised its speed far above normal, the angle of attack always being high, the point at which the lift is applied will have moved towards the middle of the wing. According to common mathematical data used to calculate the resistance of our machines, the factor of safety is less than 5.

The body is of good stream line form. At the juncture of the wings with the body, the structure is strengthened crosswise by steel tubes, 30 mm. in diameter, which make a solid piece of the whole structure. One of the characteristics of this machine is the enormous tail plane, 3.84 sq.m. The vertical fin is rather small. It has a surface of about 1 sq.m., and balances by about 1 to 5. The landing gear is the usual type, two wheels with elastic springs. In the center of the axle is mounted a sprag which is operated by the pilot to lessen the run on the ground. The wing assembly differs from our biplane in the excessive stagger and the inclined interplane struts with respect to the plane of longitudinal symmetry of the machine. The wings are perfectly symmetrical with respect to the axis of the machine, the couple of the engine being corrected by a diversity of incidence, but this gives rise to inconvenience when changing the rate of speed. Weights of the machine and its parts are: Radiator and water, 43 kg.; wings and armament mounted on wings, 152 kg.; body without wings, radiator, etc., 614 kg.; accessories, 60 kg.; instruments, gas, oil, 355 kg.; whole machine, 1243 kg.

ALPHA APPARATUS

[The Alpha Apparatus for Discovering Buried Metallic Objects. By "A." *Memorial de Artilleria,* Apr, '18. 1000 words.]

This instrument was invented for the purpose of locating buried and unexploded shells in order to prevent damage by explosion when the ground was farmed.

It is based on the principle of the Hughes' induction balance which, in turn, is based upon the electrical principle that when an intermittent and oscillating current originated in a Ruhmkorff coil is run thru two separate and identical indicator coils, an electromotive force is induced in two secondary coils placed in juxtaposition to the indicator coils.

The electromotive forces are, or should be, always in equilibrium, and consequently no noise or buzzing is heard in the two receivers (telephone) which are attached to these coils. When one of the indicator coils and its secondary coil approach a metallic object, the equilibrium of induced forces is upset and a slight buzz is heard in the receivers.

This apparatus is made of wood in the form of a V with the apex up. The indicator coils and secondary coils are wound on wooden disks at each end of the V-arms. The operator carries this machine suspended from the shoulders with a strap. An assistant carries the Ruhmkorff coil and batteries.

AMBULANCE

See also

SANITARY SERVICE—TRANSPORTATION OF SICK AND WOUNDED—MOTOR AMBULANCES

AMERICAN REVOLUTION

—Naval Operations

See also

JONES, JOHN PAUL

AMMONAL

See

EXPLOSIVES

AMMUNITION

See also

BULLETS
EXPLOSIVES
MACHINE GUNS—AMMUNITION SUPPLY
MACHINE GUN—AMMUNITION
MUNITIONS

—Supply and Transport

See also

FIELD ARTILLERY—AMMUNITION

AMPUTATIONS

[The Relation Between the Amputation and the Fitting of the Artificial Limb. Contributed by the Division of Miliary Orthopædic Surgery, Office of the Surgeon General. *Military Surgeon,* Feb, '18. 4700 words. Illustrations.]

(This article was prepared for the purpose of inviting attention to those points in the technic of amputations which have a direct bearing on the fitting and wearing of a substitute. Too little attention has been given by surgeons to the fitting of artificial limbs. As a rule the patient is turned over, without supervision, to the care of the artificial limb maker. Hence the surgeon frequently errs in comparatively simple details which a knowledge of the fundamental points of the artificial limb maker's art would enable him to avoid.

The question of amputation is one of the most serious problems the army surgeon must face and one that calls for calmness under stress and for the exercise of the soundest surgical judgment. When the requirements necessary to conserve the safety of the patient have been met, the sole remaining consideration is to be given to securing the stump which will best meet the demands made upon it by the artificial limb.

This article is of especial interest to all military surgeons, and should be consulted by them in the original. It is impracticable to cover the subject adequately in a condensation.)

ANCIENT WARFARE

See also

JULIUS CAESAR

ANTI-AIRCRAFT ARTILLERY

See also

AERONAUTICS—ATTACK—PROTECTION AGAINST
FIELD ARTILLERY—FIRE—AGAINST AIRCRAFT
FIELD ARTILLERY—TACTICS (Article: "Artillery and Aviation," Dec, '17)

—Range Finding

[Fire Against Aerial Targets. By Capt. Curti. *Schweiz. Zeitschrift f. Art. u. Genie.,* Feb and Mar, '18. 4150 words. 23 figs.]

Shooting against aerial targets involves new calculations. We here discuss the elements thereof, together with a graphical method of calculating the elements of the trajectory and a mechanical device for correction for time of flight.

The trajectory.—The hodograph.—If v is the velocity of the projectile at any point, q the corresponding acceleration due to air resistance, and c the ballistic coefficient, then $q = c.f(v)$. The acceleration due to gravity is g. Let p represent the resultant acceleration. Then $p = dv/dt$.

Let v_0 represent the initial velocity, and θ_0 the angle between the horizontal and the tangent to the trajectory at the gun. With O as origin lay off $OB = v_0$ on a line making the angle θ_0 with the horizontal. On this line lay off the distance $q_0 = c.\ f.\ (v_0)$. From O lay off the vertical distance g. Construct the resultant p_0. Through B draw a line parallel to p_0. Assume that in the time dt the angle θ_0 is diminished by $d\theta$. From O draw a line making with OB the angle $d\theta$, cutting the line drawn from B as at C; OC is then the velocity at the end of the time increment dt. By proceeding similarly with OC and the new v, we can obtain a point D, such that OD represents the velocity at the end of a second time increment dt, and so on. The curve drawn through B, C, D, is the hodograph. To determine f (v) we use the tables of Siacci.

The principal equations.—Through C draw a vertical line cutting OB as at A. Then $BC = p\ dt = (dv/dt)\ dt$; $AC = g\ dt$; $AB = q\ dt = -c.\ f.\ (v)\ dt$. The horizontal projection of AB is $AB \cos\theta = -c.\ f.\ (v) \cos\theta\ dt$. But the horizontal projection of $AB = d\ (v \cos\theta)$. Therefore

$$d\ (v \cos\theta)/dt = -c.\ f.\ (v) \cos\theta. \qquad (1)$$

From C draw a line perpendicular to OB, cutting OB as at J. Then $CJ = AC \cos\theta = g\ dt \cos\theta$. And $CJ = (v - dv)\ d\theta$. Therefore

$$v\ d\theta = g \cos\theta\ dt. \qquad (2)$$

neglecting dv, which is small compared to v. Eliminating dt from (1) and (2),

$$d\ (v \cos\theta)/d\theta = v.\ c.\ f.\ (v)/g. \qquad (3).$$

This is the differential equation of the hodograph for the trajectory in air, containing three variables, viz., v, θ, and c. The latter diminishes with the altitude, because of decreasing air density. It has the following values:

y	(δ/δ_0). c
0	1.00 c
1000	.90 c
2000	.81 c
3000	.73 c.

In vacuo, $c = 0$, hence (3) becomes $d\ (v \cos\theta)$

$= 0$; i. e., the hodograph is a vertical line. $v \cos \theta = v_x$, a constant.

The remaining equations.—(2) is derived from triangle ACJ, and therefore applies in vacuo as well as in air. From (2)

$$dt = \frac{v.}{\dot{v}} \quad \frac{v\, d\theta}{g \cos \theta} = \frac{v^2\, d\theta}{g\, v \cos \theta}. \qquad (a)$$

Since $v \cos \theta = v_x = dx/dt$, it follows that

$$dx = -\, v^2\, d\theta/g, \qquad (b)$$

and since $\tan \theta = dy/dx$,

$$dy = -\, v^2 \tan \theta\, d\theta/g. \qquad (c)$$

Since $d \tan \theta/d\theta = 1/\cos^2 \theta$, it follows from (a), (b), and (c) that

$$dx = -\, (v \cos \theta)^2.\, d \tan \theta/g, \qquad (I)$$

$$dy = -\, (v \cos \theta)^2.\, \tan \theta.\, d \tan \theta/g, \qquad (II)$$

$$dt = -\, v \cos \theta.\, d \tan \theta/g, \qquad (III)$$

$$ds = v\, dt = -\, v^2 \cos \theta.\, d \tan \theta/g, \qquad (IV)$$

and from (3) $d\,(v \cos \theta) = 0$ in vacuo, and

$$d\,(v \cos \theta)\ /\ d\theta = v.\, c.\, f.\,(v)\ /\ g \text{ in air.} \qquad (V)$$

The integration of (V) either graphically, mechanically, or analytically, gives values of v and θ, which, being substituted in (I), (II), and (III), give us the trajectory and time curve.

Graphical construction of trajectory.—The value of c (aside from the density factor) can be determined from Siacci's tables by the formula $c = (Du - Dv_0)/\ X$, or $c = (Tu - Tv_0)/\ t \cos \varphi$.

Now draw the line OB from the gun at O to any point B, making the angle θ_0 with the horizontal. Assume any value for $d\theta$, and draw the line OC, the point C being found as already described. The horizontal projection of OB is $v_0 \cos \theta_0$, while that of OC is $v_1 \cos \theta_1$. The mean of these values, applied to (III) and (I), will give dt_{0-1} and dx_{0-1}; ds_{0-1} is then drawn approximately parallel to OB, and ds_{1-2} to OC. The point 1 (extremity of ds_{0-1}) having been determined, the corresponding value of δ may be found; from this we obtain q_1 and p_1; construct CD parallel to p_1; the horizontal projection of CD is $v_2 \cos \theta_2$; the mean of the latter and of $v_1 \cos \theta_1$, applied in (III) and (I), gives dx_{1-2} and dt_{1-2}. The process is thus continued, $d\theta$ being kept constant.

This method of computation has been tested by actual firing with the 7.5 cm. gun with quadrant angles of departure of 45, 55, and 64 degrees; in the two former cases the observed trajectory did not entirely agree with the computed trajectory, the assumption of a constant value of $c = .73$ being inaccurate. To make the computed agree with the observed trajectory, note the amounts by which the ordinates differ. Plotting these amounts, we find that they lie on a curve of the form $\Delta y = \zeta x^3$. Expressing the equations of the computed and of the observed trajectories in the forms

$$y = x \tan \varphi - Ax^2\,(1 - Kx)$$

$$y^* = x \tan \varphi - Ax^2\,(1 - K^*x)$$

it follows that $\Delta y = y - y^* = Ax^3\,(K - K^*) = Ax^3\, \Delta K = \zeta\, x^3$.

The graphical method does not have the indisputable accuracy of the analytical method. Nevertheless it must be remembered that in ballistics mean values are always used to make integration possible; that these relate to the cosine of the tangent to the trajectory; that their inexactitude becomes greater, the more rapidly θ changes; that this change is rapid in high angle fire, and requires even the analytical calculator to divide his trajectory into small arcs which permit the assumption of a mean value of $\cos \theta$ and a constant δ within the small arc.

Angle of departure.—Impact curves.—Having secured, by the foregoing methods, a sheaf of trajectories with the same v_0, but with different quadrant angles of departure, we must now determine the angles of departure for actual firing. To do so, construct lines making angles of 100, 200, 300, etc., mils with the different lines of departure. Connect the points where the 100 mil lines intersect their respective trajectories, by a curve and so for the other angles. These curves are known as point of impact curves, and connect all points which can be struck using equal angles of departure. The position of the target can be given by rectangular coordinates or by telemeter distance D and angle of site γ. The latter changes rapidly with the flight of the target. This change is shown by the indicator, which is a quarter circle attacked rigidly to the vertical arc, bearing height of flight curves and a plumb line graduated in mils. The intercept of the plumb line by the curve corresponding to the announced height of flight gives the necessary angle of departure. This must be corrected for time of flight of the projectile. Under assumption of constant height of flight, the angle of departure can be set off automatically. Height of flight lines cut in a quarter circle serve as guide grooves for the moving end of the sight arm. The grooves are so constructed that as the quadrant angle of departure increases to 90 degrees, the angle of departure diminishes to zero.

Time of flight curves.—These are similar to the point of impact curves, but bend back more sharply for great heights. For short distances the time of flight depends solely on the range. The ordinary time fuse cannot be used with success for long ranges, as the change of barometric pressure materially affects the time of burning. Consequently clock fuses are used in calibers greater than 7.5 cm.

Graphical firing table.—This is a table with impact and time of flight curves. A straight edge,

ANTI-AIRCRAFT ARTILLERY—Continued

graduated in kilometers and seconds is pivoted at the zero point. As soon as telemeter distance and angle of site are announced, the angle of departure and time of flight can be determined from this table.

All possible trajectories with constant v_0 from a gun located at a point A will be enclosed in a dome-shaped figure produced by the rotation of the so-called boundary parabola about its major axis. All points outside this figure are beyond range of the gun. Practically, however, few guns can be elevated to 90 degrees, and the fuse can seldom be set for the maximum time of flight. The 7.5 cm. gun can be elevated to 64 degrees, and the fuse is limited practically to a setting of 280. Consequently the points in any vertical plane within range are bounded by the 64 degree trajectory and the 280 time curve. All points in space within range are enclosed in the ring figure produced by rotation of this plane figure about a vertical line at the gun. An aerial target remains in range the following times:

Velocity of target	Height of target	Travel of target	Time in seconds
40 m	2000 m	4100 m	102
	3000	3000	75
	4000	1450	36
60 m	2000	4100	68
	3000	3000	50
	4000	1450	24

Artillery projectiles are effective, because of the explosion, even when the remaining velocity is very small; the contrary is true in the case of rifle bullets. In the case of our rifle the remaining velocity in vertical fire is 0 at 3250 meters.

Flight and fire elements.—Let v represent the velocity of the target. Experience shows that the time necessary for computing firing data, aiming, and loading, is 15 sec. During this time the target moves from O to A, a distance of 15 v. If the third shot of a series fired at intervals of 7 seconds is to strike the target at Tr, then the time T from the commencement of computation to the strike of the projectile is $15 + 7 + 7 + t$ sec., where t is the time of flight of the projectile, and the distance of travel of the target is $(15 + 7 + 7 + t)$ v meters. The problem is as follows: at the time $t = 0$ the point O must be determined by distance D_0 and height H or angle of site γ_0, and velocity of the target v, and the angle α between the line of travel of the target and the vertical plane through O and the gun G, must also be determined. From these "flight elements" and the time of travel of the projectile t, the location and time of the striking point Tr, the angle of departure, and the fuse setting, must be determined, assuming constant height and direction of travel of target. Simultaneously the necessary horizontal and vertical distances to aim ahead of the target must be measured.

The distance $D_0 = GO$ is measured by telemeter. The assistant reads the angle of site and thus determines the point O, and the horizontal and vertical components of D_0, viz. H and X_0. To determine the velocity of the target, two telemeter observations are taken at times t_1 and t_2, the corresponding direction lines being drawn on a plane table attached to the telemeter, the corresponding telemeter readings being taken, and the horizontal components thereof, X_1 and X_2 being determined. This gives s, the space traveled by the target between the observations. The assistant measures the time by stop-watch. Then $v = s/(t_2 - t_1)$. The angle α may be measured by a frame bearing direction rays, held horizontal by aid of a plumb bob, or as follows: the apparent direction of flight appears in the plane of the cross-hairs of the telescope. Designate this angle β. Suppose the target is at the point Z. Then the angle β is in a plane perpendicular to the line of sight GZ, while the desired angle α is in a horizontal plane through Z. Suppose ZA the intersection of this horizontal plane with the vertical plane through GZ, A being also in the plane of the angle β. Suppose ZB the horizontal line of travel of the target, B being a point in the plane of the angle β. The ZB makes with ZA the angle α. Designate as C the point where the line of sight pierces the plane of the angle β. Let β^1 be the supplement of β. The angle of site is γ. Then $AB = \tan \beta^1 AC$; $AZ = AC/\sin \gamma$; $\tan \alpha = AB/AZ = \tan \beta^1 \sin \gamma$. On the basis of this relation curves are constructed on a quarter circle attached in a vertical plane under the telescope, the curves representing different values of β. A straight edge hanging vertically makes with the edge of the quarter circle the angle γ. The straight edge is graduated in values of α. Now observe the target in the telescope; by means of the screw turn the cross hairs into the apparent line of travel of the target; read the angle β; read on the straight edge the value of α intercepted by the corresponding β curve.

The flight elements may be set off on a flight indicator. Different indicators are provided for different velocities of target. The indicator consists of a circle bearing an arm, the center of the circle sliding in a groove. The groove is graduated to represent hectometers. The center is moved to the point X_0 on the groove. The arm is set to make the angle α with the groove. On the arm is a time scale, the first division representing the 15 sec., and the second division the $7 + 7$ sec., here-

tofore mentioned. The remaining divisions represent time of flight of projectile.

Consider now the graphical firing table showing impact and time of flight curves, to be placed in the vertical plane through GO, and consider the flight indicator to be in a horizontal plane with the groove coinciding with the horizontal projection of GO, the end of the groove of the indicator and the zero point of the firing table being at G. On the firing table set off the height of the target H by means of the horizontal slide. Now if the firing table be turned about the vertical axis at G. the edge of the table will move along the arm of the indicator. When a point is reached such that the intercept (in seconds) cut on the arm of the indicator by the edge of the table equals the time shown by the curve on the table which is cut by the horizontal slide perpendicularly above the indicator arm, then the time of travel of the target equals the time of flight of the projectile. By moving the pivoted straight edge of the table so as to intersect the horizontal slide at the same point, we determine D and γ for the point Tr, also time of flight and angle of departure.

It is possible to aim at B, but not at Tr. The latter, however, is the point of impact. We must therefore move the line of sight horizontally through an angle s and vertically through an angle h (the difference in angle of site between B and Tr.). Suppose the vertical plane through G and Tr is cut by the line of travel of the target at an angle α. Suppose Z is any point on the line of travel, and the distance GZ is given by telemeter as D. From Z drop a perpendicular to the vertical plane G — Tr, piercing it as at R. Let the distance ZTr = vt. If Z is the aiming point, then angle RGZ = s; s (in mils) = ZR/D = vt sin α/D. Assuming v = 40 m,

$$s = (40\ t/D) \sin \alpha. \qquad \text{(I)}$$

A value of t corresponding to any value of D can be found from the firing tables, whence 40 t/D can be found. Now construct a diagram as follows: draw a line from O in the direction of the target; perpendicular to this line at O construct another line; on this line lay off distances equal to 40 t/D, for D = 3, 4, 5, etc., km., all distances commencing at O; with these distances as diameters construct circles; from O draw a line making with the line drawn in the direction of the target an angle = α; from the points N where the diameters cut the circles, drop perpendiculars on the line last drawn from O, cutting the line at points L; then since ON = 40 t/D, and angle NOL = 90° — α, it follows that OL = (40 t/D) cos (90° — α) = (40 t/D) sin α = s. The circles cut from the line OL **segments proportional to s.**

In the vertical plane G — Tr, draw the line GTr. From R drop a perpendicular to GTr, cutting the line as at S. Then angle SGR = h (in mils) = RS/D = Rtr sin γ/D = v t cos α sin γ/D. Assuming v = 40 m,

$$h = (40\ t/D) \cos \alpha \sin \gamma. \qquad \text{(II)}$$

Now draw from O a line in the direction of the target; on this lay off distances equal to 40 t/D for various values of D; with these distances as diameters construct circles; from O draw a line making with the diameter line an angle equal to α, cutting the circles at point L; then OL = (40 t/D) cos α. This can be multiplied by sin γ by drawing from an origin O a line making an angle γ with the horizontal, laying off on the line the distance OL, and reading the ordinate of L. The result equals h.

The result must be altered in the ratio of $v^x/10$, where v^x is the true velocity of the target.

The angles s and h can also be measured by means of a *"Rahmen"* (angle measuring instrument, no equivalent in our service) placed in a plane perpendicular to the plane G — B — Tr.

[Fire Against Airplanes. News Notes. *Memorial de Artillería,* Mar, '18. 1500 words.]

Limits of Possibility of this Fire.—These limits are obtained by calculating points on the trajectory corresponding to the maximum range and then plotting the trajectory.

The formula is as follows:

$$y = \frac{x}{2 \cos \Phi} (\sin 2\Phi - \sin 2\Phi_0)$$

For $\Phi = 24° 59'$, the following values are found:

Horizontal meters Distance	Height meters of Flight	Actual meters Range	Angle of mils Position
1000	340	1052	340
3000	943	3144	314
5000	1390	5208	278
7000	1597	7179	228

Interval, Height of Burst, and Front Covered.—Due to the great mobility of this kind of target, it is well to obtain the maximum dispersion possible of shrapnel balls compatible with effectiveness of each ball. Taking a necessary striking force for these balls as 30 kgm.—double that which is usually required—the remaining velocity after explosion will be equal to 130 meters per second, and using the Krupp tables with the formula $I = C' (D_o - D_1)$, the maximum tangential interval of burst will be obtained.

Horizontal Distance	Interval of Tangential type explosions	Height of type-explosions		Front covered	
Meters	Meters	Meters	Mils	Meters	Mils
1000	1778	17.5	17.5	303	303
3000	1721	71.6	23.8	350	116
5000	1622	115	23	390	78
7000	1579	293.6	41.5	358	51

ANTI-AIRCRAFT ARTILLERY—Continued

Methods of Fire.—The best methods of fire for coast defense and emplaced guns is by using a predicted point and making the necessary computations. In this case each gun or battery commander will have to be provided with an angle measuring glass so that the angles of position and speed of target can be measured, and the gun will have to be provided with an alidade so that it can be laid in elevation.

The tables of fire ordinarily kept in these batteries by the section commander should be kept in this case by each chief of a gun crew, so that he may be in a position to make quick corrections in the firing data. The rapidity of fire can reach four shots per minute, and it should not be made anything under the maximum.

ARGENTINA

—Army

[Military Notes. By Lt.-Col. Velez. *Revista Militar* (Argentina), Sept, '17. 3600 words.]

(A series of comments, that do not favor condensation, upon the mission of military institutions, the fitness of the army for war, military rank and command, character and qualities of military command, commanding generals and commanders of units, Powers and duties of the President and the Minister of War.)

The Regulations for the Reorganization of the General Staff of the Army confer upon the Chief of Staff, as the representative of the President, the attributes of commander of the army.

[Military Notes. By Lt.-Col. Velez. *Revista Militar* (Argentina), Oct, '17. 4200 words.]

(Continuation)

(Notes on the functions of the Chief of Staff as commander of the armies in the field; the evolution of the General Staff since 1901 and its posterior mission; the transition period of the army and of the War College; the Regulations of 1917; obligations and duties imposed upon the Chief of Staff, including those as Inspector General, and method of simplifying same.)

The following is a résumé of what has been said heretofore with reference to the functions of the Chief of Staff:

1st. *As Chief of the General Staff:*

(a) To transact the business pertaining to his office with the five chiefs of division whose duties are to assist him.

(b) To supervise personally the selection and instruction of officers of the General Staff; to renew and classify the personnel of the same.

2d. *As Inspector General of the Army:*

(a) To transact matters pertaining to the two branches of inspection—Schools and Regulations—with the chiefs assigned to each.

(b) To attend to matters relative to the inspection of arms that are presented by the respective inspectors.

(c) To decide questions of general and special nature referred by the five commanders of division and the chiefs of the six large branches—Personnel, Arsenals, Administration, Engineers, Sanitation and Fire Practice.

3d. *In his character as the highest military authority and as the individual responsible for preparation for war.*

To assist and advise the Ministry in all matters of interest to the national defense.

[Reforms in the Argentine Army. By Col. Sebastian Ramos. *La Guerra y su Preparación*, Oct, '17. 1000 words.]

There were great injustices done thru the old law of promotion in the Argentine army. A board consisting of officers of all arms is now working on a new law to remedy this defect.

The General Staff has already been reorganized. The greatest change was in granting the Chief of the General Staff the right to inspect the army—a privilege he did not possess under the old law.

The Chief of the General Staff, in his position of Inspector General of the Army, is charged with the direction of all war preparations, including military schools.

The appointment of the Chief of the General Staff has been taken out of the hands of politicians and government administrative bodies. This is the only way in which unity of policy and stability for the army could be secured.

The new General Staff consists of 6 generals or colonels, 25 lieutenant-colonels, 41 majors and captains. These men are chosen from those officers of the old General Staff and from those honor graduates of the Upper War School who are considered to be especially talented for staff work. These officers are detailed temporarily in the General Staff. This allows every graduate of the Upper War School a chance to enter the General Staff if he shows particular aptitude for the work.

The cavalry is to be increased by 6 regiments, so that, with the present 9 regiments, there will be a total of 15.

Five new garrison posts have been built, 2 for infantry, 2 for artillery, and 1 for cavalry.

Officers in the aviation service will receive credit for double time as long as they are in that service, and besides an increase in pay of 25 per cent on the pay of their grade. The increase for non-commissioned officers will be 50 per cent on the pay of their grade.

The entire code of Army Regulations has been remodeled so that the sentences of Court Martials will be more justly imposed, and so that no outside authority can regulate their procedure. Also troop commanders have been given more authority in disciplining and punishing the troops immediately under them. They can now handle all the minor offenses themselves.

ARMISTICE

See also
EUROPEAN WAR—PEACE NEGOTIATIONS

ARMOR

See also

AUTOMOBILES—ARMORED
BULLET-PROOF SHIELDS
FORTIFICATIONS—PERMANENT—ARMORED TURRETS
HELMETS—ARMORED

ARMY

See also

ENGINEERS—ENGINEER TROOPS
OFFICERS

—Organization

See also

AUSTRIA—ARMY—ORGANIZATION
GREAT BRITAIN—ARMY—ORGANIZATION
SPAIN—ARMY—ORGANIZATION

—Organization

[A Plan for the Organization of a South American Army. By Captain J. H. *Rev. del Circulo Militar,* July, '17. 4500 words.]

The principal points to be considered in the organization of the army are:

1. The elements disposable and available.
2. The physical conditions and geographical situation of the country and of its frontiers.
3. Probable theaters of operations.
4. The most effective employment of modern weapons.

For service in war it is very important, and particularly so in South America, that the army be well prepared, be efficiently commanded, and possess great mobility.

In the organization of our army we have followed blindly the methods in vogue in the European armies, giving little thought to the great differences in all the conditions which effect such organization.

In Europe, where vast armies are maintained, it is necessary that the strategic unit be as large as possible consistent with effective leadership. Good roads and railroads are available everywhere for the movement and supply of troops; the countries possess abundant resources for the maintenance of troops in campaign; and the high commanders are thoroly trained in the handling of large bodies. With us, all is different. Our countries are sparsely settled; the roads are poor and railroads are few in number; supplies are limited in probable theaters of operations; and tho our officers were of equal ability, they would need to be of higher quality successfully to lead equally large forces.

All these considerations lead to the belief that a reduction in the strength of our army division would tend to greater mobility and be more in harmony with our needs and the capacity of our leaders.

The following organization for the Division is suggested:

1. Three regiments of Infantry—each regiment consisting of three battalions, and each battalion of five companies.
2. Three companies of machine guns—each company composed of three sections and each section having three guns, total 27 pieces.
3. One regiment of Cavalry—of three squadrons.
4. One regiment of Mounted Artillery—three groups of three batteries of six pieces, total 54 pieces.
5. One group of howitzers—three batteries of four pieces.
6. One battalion of Engineers—three companies of sappers-pontoniers.
7. One bridge train.
8. One group, communications—special units for telephony, wireless, and aviation.

Cavalry Divsion

Three regiments, each of five squadrons.
A Machine gun company—three sections of three pieces each.
A group of Horse Artillery—two batteries of four pieces.
An Engineer unit with sections for sapping and mining, wireless telegraphy, and a bridge train.

The proposed organization introduces the following changes:

Suppression of the brigade command.
Battalions of five companies and cavalry regiments of three squadrons.
Adoption of the three unit system.

The following advantages are claimed over the present division organization:

1. Simplicity—the elimination of the brigades places the Division Commander in more direct contact with the combat units and facilitates the exercise of command. Only thirteen orders would be necessary to deploy the battalions where nineteen such orders are now required.
2. The organization being more compact will require less road space and will be more easily and readily deployed.
3. The three unit system is much better adapted to present tactical methods than the 2 regiment, 2 brigade organization.
4. The additional strength in machine guns will more than compensate for the reduction of the 750 effectives.

The great difference between the present peace strength and war footing of our infantry units is a source of confusion and weakness on mobilization which increases in campaign. This is a matter for serious consideration.

(Continued.)

[On the Battle Unit. By Col. K. Egli. *Schweiz. Monatschrift aller Waffen,* Dec, '17. 1350 words.]

Recent changes in the organization of battle units are based on the experience of the present war, which indicates that an increase of artillery in proportion to infantry is necessary.

Clausewitz viewed the organization of large units from a strategical rather than a tactical standpoint, and maintained that strategically the question was not how strong a division or corps should be, but how many units an army must have. Having first determined the number of units, their strength would necessarily follow. Clausewitz was not acquainted with modern armies of millions, and the consequent necessity

ARMY—Continued

of organizing units of combined arms, capable of operating independently. The division has developed as such a unit, and the corps is only a combination of divisions, the number of the latter being varied according to the demands of the situation. This is not a development of position war merely. In 1915 an army corps on the east front engaged in an extended turning movement varied in strength in one week from three to six divisions, new ones being added to the outer flank and others taken away from the inner flank. In general the corps commander and his staff are the only permanent personnel of the corps; the troops change according to the exigency of the situation.

This change in the organization of the corps has exerted an influence on the organization of the division, which must now be better provided with trains, etc., than was formerly the case.

Meckel based his views on the battle unit on the premise that only troops in column were ready for co-ordinated use under unified leadership. He stated that experience showed that the most suitable strength of such a unit of combined arms was 12,000 to 15,000 men. Such a unit could completely deploy for battle in two hours. His views were based on the assumption that the meeting engagement from the march column was the usual type of combat. Schlichting made the same assumption. In the present war the Germans have not followed Schlichting, but have habitually disposed their troops for battle before the encounter. The French frequently followed Schlichting, with a result that unity of the troops was broken and defeat resulted. The breaking of the column is to be ascribed to the fact that the bulk of the infantry marched behind the artillery, so that, when the latter left the column to take a position, a great gap occurred between the main body and the advance troops, which were consequently annihilated by the already disposed enemy.

To-day it must be accepted as a fixed rule that the troops must be disposed for battle early enough to prevent unsupported entry of the advanced troops into combat, and to insure constant co-operation between infantry and artillery. No sensible commander will now send his infantry into battle without a previous artillery barrage. This determines the relative strength of the two arms. Six infantrymen per running meter are regarded as ample; since a battery can take care of only about 100 meters width in barrage fire, it follows that a division must have more batteries than battalions. The latter must therefore be decreased, since an increase in the batteries would so increase the length of a column as to make the division unwieldy.

[Future Organization of Armies. By a Belgian. *La Guerra y su Preparación,* Aug, '18. 5500 words]

Modern warfare finds the army equipped with a cumbersome supply of trench matériel, trench mortars, mine throwers, machine guns, small rapid fire cannon, together with a hugely augmented train of heavy artillery. In other words, the equipment of trench warfare highly immobilizes an army.

The Germans have taken a decisive step in the matter by changing their cavalry, which is one of the most powerful weapons of maneuvering warfare, into heavy artillery. It may be that this is an emergency step; it is, however, a most decided one.

While war is always opened by warfare of maneuver, the present struggle indicates that once contact is effected, both armies will dig in. Once, however, that a line gives way, open warfare sets in. As an example of this, take the eastward retreat in 1915 of the Russians from Galicia and Poland. To undertake a pursuit, the Germans were forced to leave behind their trench matériel; this equalized the combatants, the Russians checked the pursuit, and trench warfare again set in as soon as the German impedimenta could come up. An army must therefore be so organized as to be able to leave its trenches as an army of maneuver at any time.

To do this we must lighten our troops. This entails a modification of the fundamental principles of organization.

Modern arms are most essential. The platoon at present must have its automatic rifles, its grenades. The machine gun is of paramount importance.

Soldiers must specialize. With the limited period of enlistment, one cannot be everything. We must have sappers that are sappers, we need professional grenadiers, machine gunners, etc.

Units must be mixed, and each one must have several mobile depots. When an organization advances from its trenches into open warfare it must have some place where it can leave its heavy trench equipment, from which the latter may be forwarded. It is this heavy matériel that finally establishes the lines. In 1914, for instance, Verdun became a salient, due in a great way to the stores at that place. Every French salient, in fact, was at a point in the line favorable to the delivery of trench supply matériel.

Heavy artillery must always accompany the infantry in the open. Automobiles and tractors will easily take care of this. More heavy engineer supplies must go forward. Infantry must have its own depots of tools. For twenty thousand men, twenty-four hundred shovels are entirely inadequate. Infantry depots, too, must insure the immediate supply of trench mortars, etc.

Cavalry, it will be seen, will be of most service as a force with which to seize and hold positions in advance, which it cannot do as it is now organized. It must have its depots, its light infantry, its entrenching equipment. It will become the backbone of the light division.

Now the question arises as to what will become of our road space if we have all these depots. To this the one answer is the railroad. The rail systems must be pushed right up to the line of fighting.

Following is the proposed organization: a battalion will consist of three companies, a machine gun section, a platoon of grenadiers, a telegraph platoon, and a platoon of artillerymen (one pounders?). A regiment will have three maneuvering battalions, and one depot battalion. (Depot in the sense of park.) The mixed brigade will have three infantry regiments, three light batteries, a searchlight company, and a cyclist company; the division, three mixed brigades, one regiment

of medium artillery, a squadron of armored cars, a telegraph company, a railroad company, a company of sappers and miners, a balloon company, an aviation section, and trains.

In the light division the regiment will be two mounted troops, one cyclist troop with automatic rifles and reinforced by an armored car. The brigade will have two mounted regiments, a cyclist battalion, and a group of light artillery. The division will be two light brigades, one regiment of infantry, a group of medium artillery, a depot battalion, a railroad, and a telegraph company.

The army corps is one light division, two divisions, a regiment of heavy artillery, and a railroad battalion.

ARSENALS

United States

[Huge Ordnance Base in France. *Army & Navy Jour.*, Mar 9, '18. 325 words.]

An ordnance base that will cost about $25,000,000 is under construction by the United States in France. The base will include about 20 large storehouses, 12 shop buildings, 100 smaller shops and magazines, and machine tool equipment costing about $5,000,000. The project includes a gun repair plant equipped to reline 800 guns a month; a carriage repair plant of large capacity; a motor vehicle repair plant capable of overhauling more than 1200 vehicles a month; a small arms repair plant with a capacity for repair of 58,000 small arms and machine guns a month; a large shop for the repair of horse and infantry equipment; and a reloading plant capable of reloading about 100,000 artillery cartridge cases a day. There will be in addition, forges, carpenter shops and other auxiliary buildings.

ARTILLERY

See also

Anti-aircraft artillery
Coast artillery
Field artillery
Machine gun
Mountain artillery

United States

[Report of the Chief of Ordnance. *Army & Navy Jour.*, Dec 29, '17. 2500 words]

The following statements of the Chief of Ordnance appear in his annual report:

"The designs of the new large-caliber cannon for fixed seacoast mounting and for railroad-car mounting were completed, and types are under manufacture. New types of 3-inch field guns and 3-inch anti-aircraft guns are under manufacture in quantity. These guns are fitted with the drop-block type of breech mechanism, in place of the interrupted screw type previously used. The anti-aircraft gun is equipped with a semi-automatic breech operating device, while the field gun mechanism must be opened by hand, but is closed automatically upon inserting the projectile. The work of placing the new type of field gun in service has been somewhat delayed, due to the change in caliber, whereby the gun has been converted to a 75 mm. (2.95-inch) gun, and chambered for French ammunition. Thirty-five of these guns were completed prior to the authorization of this change, but will be relined and converted to the 75 mm. caliber before being placed in service. The new type of anti-aircraft gun for use on automobile truck mount has been designed and orders have been placed for a considerable number."

As to the machine gun supply he says: "The number of machine guns on hand when war was declared was so small that it was necessary to keep going at the greatest possible capacity those machine-gun factories which were already in operation and to utilize their output when the guns so manufactured had been reported by the board as efficient, even tho they may not have been reported as most efficient. Every energy has been bent to secure satisfactory output, and considerable progress in this direction is being made. Funds appropriated to date are adequate for the purpose, altho approved requirements have vastly increased, even within the last few months, both for divisional organizations and for aircraft service. Satisfactory co-operation is being had with the Signal Corps in the procurement and application of machine guns to aircraft work."

In the matter of Field Artillery material General Crozier says: "Three-inch guns with split-trail carriages are being manufactured in quantity, and the 3.8-inch howitzer and its carriage are in condition for such manufacture. The pilot 4.7-inch gun and split-trail carriage and the pilot 6-inch howitzer and split-trail carriage have not yet been completed and tested, progress of their development having been interfered with because of the need for prompt manufacture of already developed types required by the war. Very cordial and useful co-operation is being given by our Allies in regard to field artillery matériel, which is being utilized to the greatest possible extent." He says of the mobile artillery that the supply of this class of matériel to our troops will be necessarily "slow and disappointing, altho every possible advantage has been taken of the assistance secured from abroad and of the time that might be saved by producing foreign types in this country."

—Fire

See also

Ballistics

[Graphic Solutions for the Problems of Artillery Fire. By Luigi Figari, Maj. of Artillery (Reserve). *Rivista di Artiglieria e Genio*, Oct-Nov, '17. 4500 words. 5 plates.]

The writer, having given much attention to graphic methods during his active service, and having now been recalled to the colors, has taken occasion to renew his studies, and here presents several charts for use in connection with artillery fire.

I.—Chart for Rapid Solution of Problems in Artillery Fire

This chart is constructed by plotting logarithmic values of numbers as abscissas and of trigonometric sines as ordinates; on this chart are superimposed

ARTILLERY—Continued

diagonal lines and curves, permitting a graphic evaluation of all formulae involving the relations of numbers, sines and tangents; *e. g.*, determination of ballistic corrections, calculation of deflections, etc. A number of illustrations are given of specific uses of the chart.

II.—Charts for Determining the Course of Aerial Targets

A base line being laid out, as nearly horizontal as possible, an instrument is set up at each end for measuring horizontal and vertical angles. These being read simultaneously at intervals of 20" or 30", ranges are given currently by the graphic charts here illustrated.

If the range is very great, an error is introduced due to the curvature of the earth's surface. Means are provided for allowing for this.

III.—Charts for Solution of Convergence Problems, and Correction of Fire

These problems may be solved by the chart described under I, *supra;* but for siege batteries provided with horizontal base lines a different method is preferable. A logarithmic chart for this use is illustrated.

In view of the numerous uses of logarithmic charts, the writer recommends issue to siege and coast batteries of paper with logarithmic ruling, for ready preparation of any desired chart. The forms of ruling recommended are: (1) Logarithms of numbers, as both abscissas and ordinates; (2) logarithms of trigonometric sines, as both abscissas and ordinates; (3) logarithms of numbers as ordinates, sines as abscissa; (4) logarithms of numbers as ordinates, tangents as abscissas.

[Barrage Fire and Bombardment. Obregón. *La Guerra y su Preparación,* Aug, '18. 2500 words]

The author divides all artillery fire into two classes, barrage and bombardment.

For barrage fire, the "granatschrapnel" is the best ammunition. This is a shell whose head is, in effect, another high explosive shrapnel. The main shell explodes on a time fuse, the head on impact. This double burst is very favorable to observation.

Defense barrages have two different objectives. The first phase is directed against the enemy's advance, the second against his attack. The first attempts to sweep all distant approaches of the enemy, especially his artillery, the roads, defiles, fords, village exits, bridges, etc. On a long target in prolongation of line of fire, pieces differ successively in range, generally in increments of 100 meters. Enfilade fire is always best, due to depth of shrapnel's beaten zone. Artillery in a road is the best target, due to impossibility of countermarching. Infantry very easily leaves a swept road. Roads must be swept by a desultory fire at night. In the second phase a wall of fire is laid ahead of the advancing waves, and when these retire to their own trenches, a locking barrage is placed between them and their own lines. Batteries must also protect themselves from airplane attacks, employing a rapid stationary barrage 500 meters in advance of the machine.

In the offensive, a barrage must be laid behind the lines to impede the approach of reinforcements, and another barrage immediately in rear of the nearest enemy trenches to stop counter attacks. The Russians have used a third barrage behind their own men to keep them from falling back.

Fire of bombardment is directed against works, preparatory to an assault, with a view to destroying dugouts, emplacements, entanglements, boyaux, etc. It must also render flanking works unable to assist the enemy. It entails the use of high explosive shells, and a huge number of medium and heavy pieces, the fieldpiece's province being primarily the barrage. Particular attention must be paid to the destruction of all liaison matériel. Bombproofs do not exist. A fifteen centimeter shell will penetrate a shelter of a meter layer of stone, two meters of earth and a layer of one foot logs. Nothing will withstand the 30.5 centimeter projectile.

—Fire—High Angle

See also

MORTARS

—Fire—Long Range

[The Bombardment of Paris. By Major T. E. Compton. *United Service Mag.,* June, '18. 3700 words.]

Napoleon said that "The progress of artillery is the progress of civilization." Civilization may mean reclamation from barbarism, or advance in the arts and sciences. The Germans have given proof enough that they believe that war should be barbarous, yet they have shown themselves adepts in science, philosophy, and music.

War has reached an unprecedented importance both as to numbers engaged and instruments of destruction employed. Among the latter is the long-range gun.

The subject of restricting the zone of aerial bombardment had been under discussion in the Chamber of Deputies when, on Mar 22, the bombardment of Paris was begun by a German long-range gun located about 12 km. northeast of St. Gobain, midway between Laon and La Fère, distant 120 km. from Paris.

At first the source of the bombardment was a matter of conjecture, and generally regarded as attributable to aerial activity. There was an absence of noise attending the arrival of the shell, but this is accounted for by the steep angle of descent. Some thought that a gas evolved during travel assisted the flight of the projectile, but artillery experts agree that the shell has no such assistance.

The caliber of the gun is 210 mm. and the shell is of steel 3.937 inches thick. The base of the shell is flat, and a base fuse is used. A long sheet-iron form half the total length of the projectile is used on the point to reduce resistance. The cylindrical part of the projectile is grooved to fit the rifling of the gun.

The material results of the bombardment, except in one case where a church was hit and another where a gas main was severed, have been small. Meanwhile the people of Paris go about their business with apparent indifference.

Altho at the range used there would be a considerable dispersion of the shells due to natural causes, it is probable that the azimuth and elevation of the guns

are also varied within small limits. The firing has usually been by day, and it was thought that the guns would not be fired at night because the flash would betray the location. But they have been fired at night on at least one occasion.

The location of the guns has been known approximately ever since the bombardment began, but their actual emplacements are concealed by trees, by smoke, and by camouflage, making them difficult to destroy by direct hits. One is reported out of action by explosion, but it is uncertain whether this was caused by French fire or by imperfection in the gun itself.

The battery consists of three guns, two for the bombardment of Paris and one in reserve. The site of the battery is on the reverse slope of a horseshoe-shaped hill 600 feet high about one mile northwest of Crépy-en-Laonnois. The pieces are on concrete fixed platforms. They were brought up to their positions by the Laon-La Fère railway, from which a branch line was specially constructed. It was this little branch line that betrayed the location. Aerial photographs had disclosed the location of this branch line in October, 1917, but its object was then unknown. During February the Germans began to resent strongly aerial curiosity concerning this spot and established several anti-aircraft batteries around it, thus increasing the curiosity. When the bombardment began, the secret was out and measures were instituted to bring the fire of the heaviest guns to bear on this locality.

Counter battery work proved no easy matter. Besides the anti-aircraft batteries, there is an emission of smoke by some means just prior to firing the guns. By electrical apparatus a number of other heavy guns are fired at the same instant as the long-range guns to confuse the reports and prevent location by sound.

There must needs be a great deal of work required to keep these guns in action by replacement when worn out, as their life is supposed to be 65 to 70 rounds, and alternative positions are also probably prepared. But at this time (end of April), it seems probable that a more or less continuous bombardment must be expected for many months to come. At least this should be assumed and prepared for.

Experts agree that with an elevation of 45 degrees to 55 degrees and sufficient initial velocity, the projectile would rise to the rarefied atmosphere at 10 to 20 miles altitude where it would meet with little resistance, and there is nothing extraordinary in a range of 75 miles. There is no necessity to assume any new invention in either the gun or shell. The long-range gun has been brought into use by the Germans because they had a definite object in view which they considered to warrant the trouble of producing it. The Allies saw no such reason for constructing a long-range gun, but undoubtedly steps will now be taken to do so.

Gen. von Rohne, in the *Vossische Zeitung*, gives 125 miles as the maximum range of these 210 mm. long-range guns, with a maximum ordinate of the trajectory of 19 miles. M. Nordman considers an initial velocity of 4600 f.s. as sufficient. Other authorities suggest 4900 f.s.

Gen. Chappel believes that the Germans set to work to build these long-range guns as soon as their entrenched line was established in 1914, and that consequently it has taken 3½ years for experiment and construction. This, however, is mere conjecture. Our gun may be produced in one-third of that time, but what will it be used for when ready? Much depends on the accuracy shown by the gun when finished.

Latest reports (Apr 27) which may be regarded as official, indicate that but one of the three guns at Crépy-en-Laonnois is in action. The gun that burst has been removed and has not been replaced, and another has been hit by a French shell.

The use of this gun at night seems to be becoming more frequent. If ten heavy guns are fired at the same time with it, it will be as difficult to distinguish its flash by night as to locate it by sound by day. Meanwhile let us hope that the French gunners will account for the one gun remaining in action.

[Long Ranges. By O. Mata. *Memorial de Artillería*, July, '18. 12,000 words. Tables, figures.]

This article was written in answer to many questions which arose after the bombardment of Paris by a German gun at a range of between 110 and 120 kilometers.

The questions which came up referred to the possibilities of obtaining accurate fire at long ranges and the theoretical calculations upon which this fire was based and by which it was controlled.

The authors prove that fire at long ranges (110 kms.) is perfectly possible, and deduce certain formulæ which are applicable to all ranges, for all angles of sight, and for either high or low velocities.

From these formulæ tables of co-ordinates of various trajectories are calculated. The article is a mathematical deduction almost in its entirety, and should be read in the original as it does not permit of condensation.

—Fire—Unexploded Shells

See

Alpha apparatus

—History

[On the Different Systems of Nomenclature of Artillery. *Schweiz. Zeitschrift f. Art. u. Genie*, Dec, '17. 2100 words]

The artillery has the reputation of being the most conservative of the different arms. This characteristic appears in the nomenclature of the different types of artillery, which are still used tho no longer accurate.

Passing over the droll names, such as "Crazy Grete," "Long John," etc., of the earliest artillery, some of which have been revived in modern times, and omitting the distinction between "field snakes," "falconnets," etc., guns were, in the time of the smooth-bores, classified as cannon, howitzers, and mortars, which terms are defined by Rohne in the *Artilleristiche Monatshefte* as follows: cannon were guns which fired solid iron shot with a constant powder charge made as strong as possible so as to produce a flat trajectory against a vertical target. The range was changed by changing the elevation. Mortars were guns which fired stone shot, later shell filled with explosive, which traveled in a greatly curved trajectory, and struck the target from above. Changes in the range were ordinarily

ARTILLERY—Continued

produced by altering the powder charge, which was weighed for each shot. If great accuracy was desired, an elevation of 30 degrees was used; if great penetrating power was of particular importance, 60 degrees; an elevation of 45 degrees was used in exceptional cases for long ranges. The howitzer was a later development, midway between the two other classes. The original purpose was to fire shell with a flat trajectory. The powder charge had to be stronger than that used for the mortar, but weaker than that used for the cannon, as otherwise the shell might burst in the barrel. Later the howitzer acquired its peculiarity of curved fire. The range could be altered by changing either the elevation or the powder charge, and thus any desired angle of fall could be produced for any range, the choice depending on the nature of the cover in front of the target. Two other types, the short cannon and the bomb cannon, whose function was to fire shell at great ranges in a flat trajectory, with a powder charge somewhat less than that of the long cannon, later became employed for indirect fire, with changeable powder charges, and consequently belonged to the howitzer class.

According to another classification guns are field, mountain, or position guns. Field guns belong to the field artillery and their weight and construction were so designed as to enable them to accompany the field army. Field guns were always cannon. Mountain guns were those especially constructed for transportation on pack animals, for use with the infantry in places where wheel transportation could not go. From a ballistic standpoint they occupied a middle ground between cannon and howitzers. Position guns included not only those installed in fortifications, but also those used in the attack of positions. They included all ballistic classes. With the development of permanent fortresses there was added another class known as fortress guns, which included all ballistic classes used in fortress defense. Changes in organization have altered this classification. Position artillery in the German classification is now known as foot artillery, and all guns formerly pertaining to this class have been scrapped except a long 12 cm. cannon. Further confusion in classification was produced by the assignment of howitzer batteries to divisions, and by the organization of heavy howitzer batteries independent of a division.

The ballistic classification became confused when rifled guns were introduced. The first of these were called cannon, but were really howitzers, using variable powder charges. The typical short cannon (122 mm.) is indifferently known as the Rimailho howitzer. It is generally stated that cannon are direct fire guns, while howitzers and mortars are curved fire guns. This distinction is convenient, but not accurate, since the light field howitzer is a direct fire gun.

Rohne makes the following classification: All guns which fire with a fixed power charge are cannon, whatever the initial velocity. All other guns are divided into those which always fire with an elevation of 45 degrees or less, those which always fire at a greater elevation than 45 degrees, and those which fire at either less or greater than 45 degrees. For the above classes we propose the following names: long cannon, short cannon, mortars, and howitzers. The German light field howitzer is a "short cannon"; the German 21 cm. mortar is a "howitzer"; the Austrian and French heavy mortars are "mortars."

—Materiel

[The German Long Range Gun. *Army & Navy Jour.* Mar 30, '18. 1200 words.]

The Germans began, Mar 23, a bombardment of Paris by long range guns situated in the Forest of St. Gobain west of Laon, about 66 miles from Paris. The shell is 8.8 inches caliber and 20 inches in length. It weighs 200 lbs. and contains less than 20 lbs. of explosive. All experts agree that at such a tremendous range even approximate accuracy is out of the question and therefore the gun is of use only against a target like the city of Paris. The object aimed at is moral effect rather than material, but in both respects the gun is likely to prove less effective than airplane raiders.

[Artillery of the Future. *Canadian Military Gazette,* Apr 23, '18. 230 words.]

Prof. Fritz Reusenberger, an artillerist, manager of the Krupp works and builder of the famous 42 centimeter gun, who is now said to have planned the giant long-range guns, in an interview printed in *The Berliner Tageblatt* in February of 1916, declared that artillery so large and powerful that it would be possible to bombard England from the continent would be the certain product of the near future. The codirector of the Krupp works declared the day of flat trajectory pieces was past, and that mortars and vertical shooting artillery would be in increasing demand. This, he said, was because the nature of modern warfare had almost done away with the necessity of shooting horizontally, it being possible to reach horizontal trench lines only by shots from cannon shooting vertically.

Modern artillery, notwithstanding its tremendous strides, the Professor said, had in no wise reached the limits of its possibilities either in effectiveness or in carrying power. The cannon of the future, he believed, would be able to penetrate the strongest fortified shelters and nullify "England's shimmering armament, the old proud wall which for centuries has protected it from the continent."

Germany

[Naval Cannon Used by the Germans on the Western Front. Cronica. *Memorial de Artillería,* Jan, '18. 1000 words]

There has been a great increase in the number of long-range and heavy type cannon used by the Germans opposite the British front. As the Germans have not the facilities readily to construct a large number of these guns, they must have been removed from warships.

A glance at the list of German warships shows that this could be done without seriously diminishing the power of the German battle fleet.

Germany has battleships constructed from 20 to 36 years ago—out of date for naval operations—from

which she could get thirty-four 6 in. guns, fourteen 8.2-in. guns, 234 5.9-in. guns, seventy of 9.4-in. caliber, and twelve of 11-in. caliber. All these guns are between 35 and 40 calibers in length and are well adapted to the bombardment of the zone of the L. of C. at high angles.

It is also to be presumed that, in view of the defensive power of mines and torpedoes, the Germans have dismounted many of their big coast defense guns and have shipped them to the western front for use in long-range bombardments.

[The Long Range Gun. By Major J. Maitland-Addison, R.A. *Journal of the Royal Artillery,* July, '18. A Lecture Delivered at the Royal Artillery Institution, on Monday, May 13, 1918. 7000 words. 6 diagrams.]

The French have given the German long range gun several names among which are, "La Grosse Berthe," "La Princesse Lointaine" and "L'Imbécile."

A marked advance has been made in artillery, for a projectile has been thrown a distance four times greater than has ever been previously attained. It is the purpose of the article to explain simply the various factors which co-operate towards this achievement. There is nothing about this gun which differs except in degree, from the ordinary gun, that is to say, no new discovery has been made which by itself has enabled the enemy to effect what he has done in this respect.

On Mar 23, 1918, Paris was astonished by a bombardment which lasted thruout the day. At first it was thought that bombs were being dropped from airplanes, but this was soon dismissed as none were seen. The conclusion then reached was that such a range as the distance between the German front and Paris was obtained by a powerful gun, but only by the projectile itself becoming a gun at some part of its trajectory and ejecting a secondary shell to complete the great distance of 75 miles.

In 1915 the Germans caused no little surprise by firing shell into Dunkirk from Dixmude, a distance of 20 miles, and since then a considerable amount of long range firing has gone on along the front.

Air Resistance to Projectiles

Projectiles being fired from the German long range gun are supposed to commence their flight at a velocity of almost 1 mile per second or 3600 miles per hour. The resistance increasing as the square of the velocity, we see at once that we are beyond our experimental knowledge of velocities which is about 4000 feet per second. With a radius of ogive of 10 calibers we get an air resistance of 2480 pounds.

Diminution of the Atmospheric Density as the Altitude Above the Earth's Surface Increases

If the density of the air were uniform thruout, implying a total height of 30,000 feet the resistance to projectiles would be so great that such super-ranges as are now being obtained would be beyond our efforts, even for very high velocities of projection. But it is a fact that the density diminishes very rapidly with the altitude above the ground and consequently the resistance offered by the air becomes so reduced that as the projectile ascends, its motion becomes less and less affected, and so, in the case of the projectile from the long range gun, it tends to travel as if in a vacuum.

Following the isothermal law in the calculations, the density at 20,000 feet is about half its value at the ground, one-ninth at 60,000 feet and at 100,000 feet or about 20 miles it is only one-thirty-sixth, so that at such a height each cubic foot should contain about 15 grains of air, as compared with 534 grains at the ground.

It is this diminution of density in the upper regions which alone allows the projectile to travel unimpeded, thus giving such a great range as 75 miles.

The Ballistic Efficiency of a Projectile

The modern elongated projectile with its long tapering head has great ballistic efficiency, because of its good shape and heavy weight for any given diameter.

If we give this projectile a sufficient initial velocity and project it from a gun at a high angle of elevation, it will reach the upper strata of the atmosphere; and as the air becomes rarefied so in proportion the ballistic efficiency or ballistic coefficient increases. For any given caliber of well designed projectile, there is a certain height above the ground at which point the effect of the air resistance becomes negligible and the ballistic coefficient for all practical purposes becomes infinite. The projectile will then travel in the parabolic curve first pointed out by Galileo in 1610. This is what is happening in the case of the German long range gun and, thruout the major portion of its trajectory, the projectile is describing this path as an actuality, for the first time.

The Trajectory of the Long Range Gun

With an angle of projection of 50 degrees and an initial velocity of 5000 f/s, the projectile rises to a height of 12½ miles in 25 seconds, the inclination of the trajectory changing from 50 degrees to 41 degrees, the horizontal advance being also 12½ miles. At this point the air density diminishes to about one-tenth of its value at the ground, and the ballistic coefficient of the projectile, which is 10 units at the ground, increases 10 times.

From this point the projectile practically ignores such slight air resistance as there is in the region above it, and its motion becomes parabolic to a point at the same level on the descending branch, the horizontal distance to which is about 65 miles from the gun. Thus 52½ miles or about 70 per cent of the whole trajectory lies in what may be termed the Parabolic Region of Flight. The projectile passes thru the vertex at a height of 23.9 miles, the horizontal distance to the vertex being about 39 miles.

On the descending branch, the velocity which is reduced to 2267 f/s at the vertex, commences to increase rapidly attaining its maximum of 3088 f/s at 7½ miles from the ground and 6 miles horizontally from the point of arrival. It then diminishes owing to the rapidly increasing air density and the projectile finally reaches its destination at a velocity of 2626 f/s. Since this is 2½ times the rate at which sound travels, there

ARTILLERY—Continued

is no possibility of any one hearing it coming, even for a fraction of a second.

It will be seen, therefore, that in determining the trajectory, the air resistance has to be taken into account at the two ends only. The trajectory may be considered as being on two stilts and it is on these two stilts that careful attention must be given to the exactitude of the calculations. The angle of arrival on a tangent to the earth thru the gun is about 54 degrees 40 minutes, which is only a little greater than the angle of departure, and, allowing for the earth's curvature, another 1 degree 6 minutes has to be deducted, so it is actually 53 degrees 34 minutes.

Subsidiary Problems in Connection with the Trajectory

The earth's curvature adds ½ mile to the range. The correction varies as the square of the range.

The earth's rotation is also responsible for a correction to either the direction of shooting, or to the range or to both, according as the direction of the fire is from pole to pole, parallel to the equator, or inclined to both. This correction is also dependent on the latitude at which the firing takes place. In this case, the direction of fire being southwest and latitude 50 degrees, there would be an excess of about 700 yards of range and a deviation to the right of about 400 yards.

The drift will probably be less than at first supposed due to the height of the trajectory. There would be less than 1 mile of deviation in 100 miles of range.

The accuracy of the gun is such that a small error in the elevation for maximum range would not appreciably affect the range, so that a little jump or whip in the gun is of no great importance. However a varying error in the muzzle velocity from round to round, if it be large, vitally affects the accuracy. It may be difficult to maintain a constant M. V. in such a gun. For example, 2 per cent change in the M. V. alters the range in this case by over 3 miles.

The Projectile

The shell presents features that are distinctly novel. It is built up, instead of being made as a whole; in this way, manufacture and filling are much facilitated. The shell is divided into two principal parts, entirely different in characteristics and functions. These are:

(a) The body and shell proper.
(b) The head.

The Body.—The walls of the shell are abnormally thick, tapering towards the front where the danger of deformation due to "set back" diminishes. This is an indication that the pressure to which the gun is worked is in all probability greater than usual. There are two rotating bands of copper on the shell, one at two inches from the base of the shell and the other eleven inches from the base. These are one inch wide. The caliber is 8.28 inches and the shell over all is almost 4 feet high. Besides these copper bands, which assist in rotating the shell and in effecting a gas seal, the shell is itself rifled for 3½ inches above each band. This is a reversion to old practice. The thrust of the rifling of the gun on the shell is thereby much more evenly distributed along the shell, and failure to rotate which might result if the two copper bands were alone called upon to do this work, is thus eliminated.

There is a diaphragm inside the shell just under the upper rotating band. This increases the strength of the shell, and by dividing the bursting charge into two parts, lessens any risks there might be, due to the "set back" of the explosive towards the base. In this diaphragm there is a base impact fuse, as well as in the base.

The capacity for high explosive is small, and the burster would weigh about 33 pounds, or 10 per cent of the weight of the shell.

The Head.—The head is a comparatively thin pointed steel dome struck with a radius of about 10 calibers. The function of this head is to diminish the air pressure and to throw the center of pressure well forward of the center of gravity, a principle which, given the requisite twist of rotation, increases the steadiness of the projectile during flight.

The rifling on the shell indicates a slope of 4 degrees or a uniform rifling in the bore of 1 in 45 calibers.

The Gun

Assuming a maximum working pressure of 21 tons per inch and supposing that it were possible to maintain a constant pressure of this magnitude all the way down the bore, the author has calculated the length of the shot travel to be 50 feet. By internal ballistics, with an average pressure of 15 tons, the length must be 75 feet for the shot travel. Adding to this a minimum length of chamber of about 15 feet for a very large propellant charge, we get a total length of the gun of 90 feet.

The amount of propellant is about 400 pounds which is 70 pounds in excess of the weight of the projectile. If a cord propellant is used, its diameter would be 0.6 inches. As regards the life of the gun, it is quite possible that, with this particular caliber of gun, it would be able to fire 600 or 700 rounds before requiring relining.

The Mounting

The gun has been pictured as being mounted on a very ordinary type of standing carriage erected over a deep excavation in the ground; for it is inconceivable that a gun of such length could be fired at the correct angle of elevation from any form of railway mounting or even from a long elevated bed of concrete. The gun could be more easily transferred from its position on railway trucks, to this kind of mounting. It is practically certain that the gun has to be brought to the horizontal position for loading. It is not possible to say whether any arrangements exist for traversing.

Recoil

The energy of recoil is greatly subnormal on account of the great weight of the gun and recoiling parts, relative to that of the shell. In this case the ratio is between 600 and 700 to 1 as compared with the normal ratio of 120 to 1 in most guns.

Summary

To summarize, the factors which bring about such long ranges are:

High ballistic coefficient of projectile.

High velocity.

Velocity alone is useless without high ballistic coefficient, and the greater the caliber of the gun we employ, the greater will this coefficient be. Given both requisites, the rapidly diminishing air density with altitude does the rest.

The employment of a long and heavy gun is inevitable.

As regards the pressure to which these guns should be worked, the higher the pressure the shorter the gun within limits. But to use much higher pressure than those at present, is not very feasible or desirable.

Conclusion

There is nothing abnormal about this gun, but we must now take the long range gun seriously. It has come to take its place among the other weapons being used in this great war. The employment of such a gun will not win the war, but it fulfills its mission as does each engine of war devised. It will probably have a rapid development in the future; but, peace or war, it must be considered.

—Use of in European War

See also

EUROPEAN WAR—WESTERN THEATER (Article: "Impressions of a Visit to the German Front in Belgium")

ASHBY, Turner and Richard

[Two Confederate Colonels. By Percy Cross Standing. *United Service Mag.*, Mar, '18. 1500 words.]

Colonels Turner Ashby and Richard Ashby, less well known than such men as Stuart, Forrest, Morgan, Mosby, Sheridan, Custer, and Stoneman, took a scarcely less distinguished part in the earlier phases of the Civil War. Both were associated with Jackson's Valley Campaigns, and both fell on the field of battle. Both were magnificent horsemen, and at the beginning of the war they raised a force of cavalry, and "Ashby's Cavalry" became a household word in the North.

Richard Ashby was killed near Patterson's Creek, W. Va., in a desperate affair with Wallace's Indian Zouaves. Turner Ashby executed a brilliant raid on Harper's Ferry in the autumn of 1861. He was twice offered the grade of brigadier general, which he declined on the ground that he had no special fitness except for the command of cavalry composed of men whom he knew, operating in a region with which he was familiar. He finally accepted the grade after urgent appeals as a matter of expediency.

Turner Ashby frequently penetrated the Federal lines in disguise, on one occasion visiting General Bank's headquarters disguised as a market woman, and there gave a description of himself.

He became known as the "Black Horse Colonel," on account of the color of his charger. Reckless daring resulted in his death in action near Harrisonburg, Va., June 6, 1862. Had he survived he would undoubtedly have achieved a high position in the Confederate service.

ASPHYXIATING GASES

See also

EUROPEAN WAR—GENERAL NOTES ON OPERATIONS, BY THEATERS—WESTERN THEATER (Article: "The Condition of the Western Front")

RESPIRATORS

[The Hun's Poison Gases. By Dr. J. B. Huber. *Leslie's Weekly*, July 6, '18. 600 words.]

The Germans use many different poison gases. The first used was chlorine, liberated from cylinders on favorable wind. Protection against this gas is afforded by a respirator using alkali carbonate or thiosulphate as the neutralizing agent. Against carbonyl chlorid, or phosgen, partial protection is furnished by helmets saturated with sodium phenate.

Three things make gas attacks effective—(a) increased concentration of the gases so that the protective devices do not suffice; (b) surprise attacks in which protective devices cannot be used in time; and (c) new gases against which the respirators do not give protection.

Following the use of gas clouds came the use of gas shells. The tear gases are used in shells. The tear gases are—xylol bromid or benzyl bromid, of which one part in a million will inflame the eyes; trichlormethyl-chloro-formate, which at times actually passed thru the gas masks; phenyl-carbylamin-chlorid, still more harassing and introduced last summer.

Next came the sneezing gas—diphenyl-chloro-arsin, designed to prevent the use of the gas mask. Latest of all has come the super-lachrymator, the so-called mustard gas (= dichlor-diethyl-sulphid). As many as 50,000 mustard gas shells have been fired in a single night's bombardment. The effect of this gas on the eyes is not immediate beyond a slight irritation. After several hours the eyes practically blister, causing intense pain, coryza, coughing, and even vomiting. Direct contact with the spray will blister the skin; the concentrated vapor penetrates the clothing, and the respirators are no protection.

The Germans use hand grenades filled with bromin, chloracetone, chlor-sulphonic acid, sulphur trioxide or dimethyl sulphate. Their chemists, according to Major S. J. M. Auld, of the British Military Mission to the U. S., are working for "a colorless, odorless, invisible, and highly poisonous gas." Meanwhile the Allied chemists are not idle.

—Physiological Effects of

[A French Gas Attack. German version by Prince Adalbert of Prussia. From the transl. in *Kungl. Vetenskaps-Akademiens Tidskrift,* May, '18. 1000 words.]

During the year 1917 Prince Adalbert of Prussia, the third son of the German emperor, commanded a battalion of marines at the front in Flanders. His impressions he has described in a little book called "With My Battalion in the First Line," in which he describes a French gas-attack. In a dugout below a village which was shot to pieces, the prince was busy at midnight putting in order some small birthday presents meant for his adjutant, when the gas alarm was given.

ASPHYXIATING GASES—Continued

"Immediately we jumped to our feet, put on our gas masks and went outside the dugout to investigate. The night was black as a raven, the air damp. A piping sound was heard, clearly indicating that the enemy was blowing out gas. We were not taken unawares. The deep sounding gongs continued to warn the defense on the flanks that the poison clouds were approaching. Close to the ground they were slowly stealing forward, terribly slowly. A pale yellow-green thick gas, an almost tangible mass approached us. The air was nauseatingly sweet and suffocating. The lungs started working as if to prevent the danger of suffocation. However, everything is in order. The men who are on guard duty have put on their gas masks. I notice, however, that one of them is trying to take his mask off. In a moment I am at his side: 'Put on your mask at once!' He mumbles confusedly: 'Wanted to take just a little bit of fresh air.' 'Man,' I cried, 'fresh air? A bit of fresh air which may be your last! Nobody is allowed to take off the gas masks.'

"Like ghosts the men are stealing forward on the ground; their covered faces give them an uncanny appearance. One after the other appears and runs past in the direction of the sounding gong. All the time the gas is whistling in our ears. The greenish poison is like a wall. Slowly, as if unwillingly, it moves itself. In the next moment it is as if hell broke loose. An artillery attack of a violence which I had not ever experienced, a raging drumfire, under which the eartn seemed to crumble. An uninterrupted crashing!

"The gas continued to whistle in our ears. The terrifying din increased every moment. The sound of the gong reached my ears. I went down to the telephone in the room of the adjutant (*Adjutantenkeller*). Here the crashing and the din were still worse. The low room which was poorly lighted by carbide lamps and candles, seemed to be filled with a dense fog. The adjutants were standing at the phones, the report carriers with gas masks were at the short ladder which led down to the room. Reports and orders were coming and going. I myself took over the service of the phone in order to be able to receive and give information quicker. To speak thru a gas mask was no easy task, however.

"The drumfire increased further. Projectiles of different calibers were incessantly falling on, at the sides, in front and behind our dugout, sometimes less, sometimes stronger, until the ground started to move in waves, when the big mines (weighing two centners) from the mine throwers, began to arrive. It was horrible, but it became still more horrible. The lamps were put out, were lit again, went out again, grenades and mines whistled and crashed; walls crushed in, our dugout was moving as if in an earthquake—a quarter of an hour or half an hour; who could look at the watch in this hell cauldron, where a minute seemed to be an eternity. All senses and nerves were tense with the question: 'Will the enemy try to break thru?' He must not succeed. In the din of our own artillery the pattering of machine guns was mixing itself, steadily increasing in strength.

"The dawn began to come. Over the bare, shelltorn ground in front of our position lay a mist like an autumn fog. Faded colors, sometimes green, then white, gray and yellow. They seemed to float together, then divide themselves into small, isolated clouds, which dissolved themselves, struggled forward and approached. The nauseatingly sweet taste in the mouth became still more perceptible, and our faces began to glow with heat under the tight-fitting gas masks in the crowded room. The concert never seemed to end. Now and then lightning crossed the dark firmament, lighting up the wall which was lying over our front line trench.

"My telephoe wires, with the exception of a single one, were shot to pieces in the twinkling of an eye. At least that one remained intact by means of which I was enabled to follow developments until the end. The firing had gone on for half an hour, but the phone still reported: 'Gas still in the first lines.' Thru all slits and joints seemingly white veils entered and filled the room with a nauseating smell which reminded us of cheap perfume. From all sides came the cracking and thundering, so that everything began to dance and the dust and mortar were stirred up everywhere.

"And the gas cloud—it was still over the first lines; the phone in uninterrupted action: Luminous balls—ammunition scarce—some casualties—not able to give numbers of them for the different companies' . . . And on top of this the unceasing thundering and crashing. . . ."

—Use of in European War

[Poisonous Gas in Warfare. By H. E. Haferkorn, assisted by F. Neumann. *Professional Memoirs*, Nov-Dec, '17, and Jan-Feb, '18. 6500 words.]

(A list of 267 references to books and periodicals bearing upon the subject of gas warfare. The article presents a short, annotated bibliography of gases and kindred devices as applied in the present war, covering their application, prevention, defense against, and medical treatment.

There is included, besides the references to gas warfare, a number on kindred devices, such as Flame Projectors, Bombs, Incendiary Projectiles, etc.)

ATHLETICS, Military

See

Gymnastics, Military

ATTACK

See also

Infantry—Tactics—Attack

[New German Assault Tactics. Notes. *Army & Navy Gazette*, July 20 '18. 400 words.]

The first line consists of the *Sturm* battalions. Other divisions, marching in rear look after flank communication and clearing out the enemy in detail. A short, intense bombardment by *minenwerfer* and all available artillery precedes the attack. Asphyxiating gases are reserved for use against artillery so as not to infect trenches to be occupied by the infantry. The battalion —in attack—forms with three companies in the first line and one in reserve, making four waves. The first wave, preceded by groups of assault, *stossgrupen*, is composed of grenadiers and mitrailleurs. The second wave is made up of good shots. To the third, of heavy

machine guns, lance grenades and liquid fire, is assigned the duty of overcoming the enemy's machine guns. With the fourth wave come the minenwerfer. The presence of the light machine guns in the first wave of attack is a new feature. The Germans claim to have taken a number of heavy guns intact by this development.

—Frontal

See also

INFANTRY—TACTICS—COMBAT

AUSTRIA

—Aeronautics

See

AERONAUTICS—AUSTRIA

—Army

See also

MORALE (Article: "Comparison and Conclusion")

—Army—Artillery

See also

FIELD ARTILLERY—MATERIEL—AUSTRIA

—Army—Infantry

See also

INFANTRY—ARMS—AUSTRIA

—Army—Organization

[The Serbian Campaign of 1915. By Major Goded y Llopis. *La Guerra y Su Preparación,* Apr '18. 22,000 words. Photos, maps.]

The conclusions deduced from the above campaign and from a visit to the Austro-Hungarian front are as follows:

War System and Organization of the Front.—The system that is in vogue is to force a war of maneuver upon a foe when it is desired to destroy him. To do this, the permanent lines are broken by heavy concentration against them, and once the enemy's permanent lines are crushed and he is forced to evacuate them, his destruction depends entirely upon the results of open warfare. The statement that permanent trench systems cannot be broken if properly garrisoned is a mistake. Nothing definite can be won by fixed trench fighting.

(The author describes the Austro-Hungarian trench systems. They are similar to all others now in use by belligerents and consist of series of two or three trench systems at intervals of from 100 to 150 meters, with accessory works in the foreground. They are so arranged that the rupture of one sector will not cause the rupture of an entire system.)

Organization and Morale of Troops.—The new weapons and new methods of warfare have caused some disorganization, breaking up of old units and more or less confusion.

It has been found that the field army is not a large enough group to operate with under some conditions, and recourse has been had to the group of field armies or army group. The army corps and divisions have been reorganized for particular missions and given the name of "Combined Corps" or "Combined Divisions." The artillery necessary for any mission has been detailed or attached to the army corps or field army. This is preferred to augmenting the divisional artillery, the regiments, or the batteries in order to reach the necessary strength.

General Staff.—General Staff officers of groups smaller than the army group are always line or field officers, colonels and lieutenant-colenels in the army corps and armies; majors and captains in the divisions and in the brigades. Officers of the General Staff Corps are very scarce—four or five officers to a field army, two or three to a corps, and only one to a division. The staffs themselves are large because of the many branches that have to be represented and which take part in modern warfare.

On the eastern front, the staff officers found it very difficult to have their orders executed, many times because of the many nationalities to which the troops belonged. A staff officer in transmitting an order over the telephone would never know in what language he would be answered. Interpreters were not entirely able to overcome this difficulty.

Mountain Troops.—Austria-Hungary had, before the war, four regiments of Tyrolean Chasseurs, or Alpine troops. This number was found entirely inadequate, so that troops were taken from other divisions and sent to training centers behind the lines where they were taught to ski, climb mountains, etc. The necessary Alpine troops to guard the mountain fronts were then organized from among these recruits.

Special Troops.—Amongst these are worthy of mention the storm battalions, electrician companies charged with the upkeep of charged entanglements, and the reserve officer schools behind the lines.

Armament, Clothing, and Equipment.—Officers have all been armed with a short knife on the bolo order. The hand grenade has been issued as an accessory to the rifle and bayonet. Troops in the mountain front are issued a wool or fleece-lined clothing for winter wear.

Morale.—The morale of the Austro-Hungarian troops was everywhere excellent. They were imbued with the spirit of defending their country from Allied invasion. The morale of troops was carefully kept up by the officers who were always particular to see that the men were given justice. The needs and comforts of soldiers were cared for and every means taken to avoid needless sacrifice of life.

—Army—Sanitary Service

[An Austrian Reserve Hospital. By Lieut. G. J. Korby, M.R.C. *Military Surgeon,* Mar, '18. 3400 words. Illustrations.]

(The writer served for some time in the 10,000 bed "K. u. k. Reserve-hospital No. 2" in Pardubitz, Bohemia. This is the largest military hospital in Austria-Hungary, and perhaps the largest in the world. The article gives a brief description of the construction, organization, administration and equipment of the hospital, together with the manner in which the wounded are taken care of from the time they arrive. The subject matter is presented in too condensed a form to admit of further successful condensation. The article is accompanied by two diet charts.)

[English Automobile-Cruisers Called Tanks. By J. M. M. *Mem. de Ingenieros,* June, '17. 700 words.]

(An article dealing with the construction of the different tanks *now used* by the British.)

[Napoleon's Horse Batteries Once Again. *Sphere,* Dec 1, '17. 450 words.]

The importance of adequate artillery support for attacking infantry has been well established since the Seven Years War (1756-1762). It was habitually put into practice by Napoleon and his great artillerists. In the early 19th century the power of defense was not what it is to-day. If mobile artillery support for infantry was necessary in those early days, how much more essential it is to-day.

But the advance of the artillery must also be covered. Guns are in themselves helpless when advancing. The tank is the logical outcome of this. It is to all intents and purposes a motor-propelled mobile gun position. Both engines and guns are protected by armor, and the continuous band enables the tank to negotiate all but the most formidable obstacles. The tanks are heavy enough, when advancing in line abreast, to lay flat belts of barbed wire. At the same time they can keep up an incessant fire right ahead as they move along in front of the infantry waves. In essence they are the latest development of Napoleon's famous lines of horse batteries advanced in front of the infantry columns—the lines which at Friedland, Wagram, and Lutzen tore the heart out of the enemy armies, and made a clear way for the foot soldiers.

[The Tanks of the French Army. By M. W. Bl. *Schweiz. Zeitschrift f. Art. u. Genie,* Feb, '18. 420 words.]

The French army uses two types of tanks, according to the *Umschau,* one 7 x 3 x 2 meters, the other 5 x 2 x 2 meters. Forward movement is produced by a chain passing over the wheels, whereas in the English tank the chain passes over the whole tank-body. The wheels are placed under the superstructure. Power is furnished by benzine or electricity, and is transmitted thru the rear wheels; the front wheels merely carry the chain. Intermediate carrying wheels are provided according to weight of the tank. Steering is accomplished by unequal velocities of the rear wheels. The chain links carry spurs to grip the ground. The greatest practicable slope is forty degrees. Inequalities of ground offer no obstacle, but small stones, roots, etc., sometimes cause the chain to slip from the wheels, and necessitate replacement of parts. Consequently the tanks are not transported long distances under their own power. The velocity varies from 8 to 10 km./hour, and the cost from 110,000 to 200,000 francs. The personnel of the large tank consists of one officer and seven men; the officer steers; one man is provided for each gun, machine gun, and motor. Tank service is arduous, because of cramped space and scant air supply; casualties frequently occur from splintering of the inner surface of the steel under impact of bullets on the outer surface.

[How the British "Tanks" Received Their Name. *Popular Science,* July, '18. 200 words.]

As the public has been unintentionally misled as to the origin of the name "Tanks," Sir William Tritton, who designed and built them, has given out the real story. In the early days of the war, Sir William's firm made some heavy tractors for hauling artillery. Regret was expressed that they could not cross trenches. This set the inventor to thinking and he evolved a tractor which he called "Little Willie." It was, of course, inadvisable to let the world know anything about this tractor, so the various parts were made in different shops, with no intimation as to their true ultimate use. The hull was called in the shop orders a "water carrier for Mesopotamia," which was soon shortened to "tank." This name stuck to the completed tractor and so came into general use.

[A Study of the Famous English Tanks. Lt.-Col. J. Grant. *La Guerra y su Preparación,* Feb, '18. 6800 words. Photos.]

Necessity for Tanks

In October, 1915, a special corps of machine gun officers was picked from the cadets at the English training camps for the purpose of forming a "Section of Armored Machine Guns." This body was formed and given its preliminary training with the utmost secrecy. Later in the year the Section of Armored Machine Guns was moved away from Aldershot, its home camp, and taken to a more secluded spot where an area had been surrounded by walls and placed under guard. Within this area was the first tank, named "Big Little William," a monster of 40 tons with a speed of three miles per hour. The construction, appearance, and armament of the tank were kept a close secret from everyone. A short while after this guarded camp had been established, two other tanks were delivered there for use.

The tank had been built for protecting men who advanced against an intrenched position. The idea dated back to the Trojan Horse.

Since the battle of the Aisne, the war had been practically a series of stationary battles on the western front, where, on account of the range and accuracy of modern weapons, both sides had been obliged to intrench. The ultimate decision was not changed by this class of warfare. It still depended upon the ability of the infantry to advance.

Once the infantry starts an advance from its trenches across No Man's Land, hostile artillery fire diminishes in effectiveness. Machine gun and rifle fire, on the contrary, become more effective than at any other time. Therefore the problem for the advance is to find some means of crossing entanglements and broken ground with protection against infantry and machine gun fire. Shields on skids and on wheels had been tried in 1914, but without success. The English decided to manufacture an automobile which could cross the barbed wire zone without being destroyed by small arms fire.

Evolution of the Tank

The idea of using caterpillar traction in trench warfare was introduced by Col. Swinton, British Army, who submitted to the Defense Council a plan for constructing tanks based on the Holt Tractor plans. Several officers of the Admiralty had ideas similar to Col. Swinton's, and the scheme was received with approval by Mr. Churchill of the Admiralty. By June, 1915, Mr. Churchill had co-ordinated all experimental work on tanks and had established two centers of investigation. The tanks were first built to climb five-foot walls, to cross ten-foot ditches, and to be safe against machine gun and rifle fire. Another condition was that they were to be low on the ground.

It required one year of experimental work before a satisfactory model was produced. Production was turned over to the Minister of Munitions in February, 1916, and one hundred tanks of the accepted model were ordered.

The new tanks were of two models—one called the "male," was armed wtih two r. f. Hotchkiss rifles besides a machine gun armament. The "female" type carried only the machine gun armament, and was used against personnel whereas the male was to be used against machine gun nests and strong points.

One of the salient features of the tank construction was the absolute secrecy with which their existence and employment were kept.

The preliminary work with tanks at the camps of instruction was carried on with the greatest difficulty. Men had to be taught the steering and handling of the machinery, the operation of rifles and machine guns in limited space, under bad conditions of visibility made worse by the uneven motion of the tank over rough ground. The noise of the motor made it impossible for the crew to communicate with each other by word of mouth. Signals had to be used. The motor gases often made the men sick; and in fact they were all subject to a form of sea-sickness in the early period of their training.

Trench systems, exact copies of a sector of the front in France, were built at the training camp, with complete entanglements, shell holes and machine gun nests. The instruction aimed to teach every member of a tank crew how to operate the gas engine, steer the tank, fire the various pieces constituting the armament, and how to make temporary repairs. Traveling shops were constructed to make important repairs.

In spite of all the difficulties, the zeal of every one connected with the new weapon was so great that by July, 1916, two sham battles with tanks were given, one before the General Staff and another before the king. On Aug 29, 1916, fifty tanks were unloaded at Havre, in France, and sent to the British front, without the enemy's knowledge.

The origin of the name "tank" is interesting. In order to keep the existence and purpose of the tanks secret they were referred to by officials as "the new drinking water containers for Mesopotamia"—and later as the "water tanks."

The Tanks in Action

The tanks went into action for the first time on Sept 15, 1916, taking part in the continuation of the Somme offensive which had been started the previous July. The object of this offensive was to drive the enemy from a line of high points extending to the east and south of Thiepval, and the principal points of support of which were Courcelette, Martinpuich, and Flers. The Germans were well intrenched and were supported by hundreds of concrete machine gun emplacements, which had many times before held up an infantry advance. It was the mission of the tanks to destroy these strong points.

The morning of the 15th of September was foggy and the tanks got into position without being seen. They were entirely successful in their mission, producing great consternation in the ranks of the enemy. The German machine gun nests could do nothing against the tanks, which advanced unhesitatingly against them, pushed them over and killed their garrisons. One tank was in action for 20 hours.

The tank crews had a most difficult task in trying to maintain communication with their own infantry and artillery.

The tanks gave the advancing infantry an admirable protection against hostile rifle and machine gun fire. They were not effective against artillery fire, as one direct hit from a heavy gun would put them out of action. The danger of this is rather small, as the tanks are constantly moving and due to their low height and their camouflage they offer a very poor target to artillery.

Another factor which contributed greatly to the early success of the tanks was the element of surprise.

Besides the ability to destroy machine gun emplacements, the tanks opened passages for the infantry thru the barbed wire, protected the infantry against rifle and machine gun fire, and often attracted the enemy's artillery fire with a consequent decrease in our casualties. The casualties in the tank personnel were relatively small.

On one occasion two tanks attacked a German ma-

AUTOMOBILES—Continued

chine gun nest. They advanced to within fifty yards and destroyed it. They were then in position to enfilade the German trenches with machine gun fire which they did, capturing 400 prisoners, which were taken to the rear by the escorting infantry. On another occasion, a tank was attacked by thirty German grenadiers, but created havoc in the German trenches and attacked a pack train of twenty-five mules with machine gun fire with great success.

The tanks became so numerous and their duties of such importance that they were finally separated from the machine gun corps and organized into to special corps under a general officer.

During this time the ranks of tank mechanics were being constantly swelled by picking men from other branches. Men for tank service were picked according to their mechanical knowledge, initiative, and ability to make a quick, accurate, decision.

The tanks in France have entered into all the battles each time on a grander scale; at Arras in April, Messines in July, the third battle of Ypres in August, doing valuable work in every engagement.

The Germans, of course, have taken measures against the tanks by organizing special tank observing groups of airplanes, by detailing special guns for tank destruction, by digging pits and keeping same well covered, and by giving the infantry a special armor piercing rifle bullet to use against them at short range.

The British consider the men comprising the tank crews to be representaive of the finest type of English soldier. They expose themselves to untold dangers and hardships with the greatest coolness in every case.

[The Tank in Warfare. *Canadian Military Gazette*, Aug 13, '18. 650 words]

The tank was a British invention and was first used in the battle of the Somme in 1916. They scored some successes there and later, namely in the battles of Arras and Messines in protecting infantry and demolishing machine gun posts, but were regarded as a costly fad. This tank weighed about fifteen tons; was easily bogged; and was very slow. The Germans then constructed a tank more heavily armored and armed, while the Allies evolved a lighter tank, easily steered and much faster. These Allied tanks have proven themselves, in silencing machine guns at Vaux and other places, to be efficient weapons of offense in dry weather, and are superior to the heavier type of the Germans.

[Tanks Doing Splendid Work. *Canadian Military Gazette*, Oct 22, '18. 400 words]

Tanks, cavalry, and armored cars are being used now more than ever before. The British have developed this weapon greatly during the past year.

The latest type of tank has twice the speed and radius of action of the earlier types. Infantry is powerless against them, as the tanks can use their machine guns in the open, can straddle the trenches and clear them with fire, and can crush in the dugouts.

The light "whippet" tank is a development of this year. They are killing machines pure and simple, of such speed that there is little chance of getting away from them. Their fuel supply is sufficient for a full day's action. There are also supply tanks for reserve gasoline and ammunition.

Armored motor cars must stick to the roads, and hence are limited in action, but they are very useful in pursuit. There are immense possibilities for adventurous use of these machines well behind the enemy's lines, where they may take possession of vital points on communications, preventing the escape of guns and transport.

[Breaking Fortified Fronts. *Army & Navy Gazette*, Oct 5, '18. 250 words.]

The Germans broke the Allied front with storm battalions, short preliminary bombardment, perfected communications, and immense superiority in numbers. For a time they carried all before them.

The Germans did not think much of tanks. Their copies were failures because they went in for colossal size. Between Soissons and Château-Thierry a line of small mobile tanks assailed the German lines and regained all the territory between the Marne and the Vesle. Since then, the efficacy of the tank as a front-breaker has been completely demonstrated. Marshal Foch has just said that he wants more of them.

—Armored—Defense Against

[New German Anti-Tank Tactics. *Army & Navy Jour.*, Oct 19, '18. 240 words.]

The Germans have evolved new methods of resisting the advance of tanks such as blowing up or weakening bridges; by mining roads; damming streams to produce marshes, and bringing special tank or field guns into the first line. The infantry are instructed to aid the artillery in groups of half a dozen riflemen or several mine throwers, and to try to put the tanks out of action by throwing bunches of grenades under the caterpillar wheels.

AVIATION

See

AERONAUTICS

AZORE ISLANDS

[The Azores. B. A. Richard. *The Mil. Hist. and Economist*, July, '18. 1700 words.]

From our present naval base, Guantanamo, only the Atlantic coast of South America as far south as the mouth of the Amazon can be protected. Some other base is necessary. England has shown her willingness to co-operate by allowing us to occupy the Azores, a Portuguese colony, coveted at times by both England and Germany. This occupation should be permanent, as a naval base in the Azores would be right in the line of any hostile operation upon South America by a European power. The Azores are only 2000 miles from New York, and 1200 miles from Gibraltar, allowing us to support England in the Mediterranean and in African waters. Supported by English or American control of the Cape of Good Hope and the Falkland Islands the Atlantic would be firmly controlled and the Monroe Doctrine established.

BALKAN WARS

See also

EUROPEAN WAR—GENERAL NOTES ON OPERATIONS—SOUTHEASTERN THEATER — SERBIAN-SALONIKA FRONT

—Military Lessons of the

[Some Balkan Reminiscences and a Moral. By Noel Pocock. *Jour. United Service Institution of India,* Apr, '18. 7500 words.]

Before the present war broke out, there was an impression growing that there would be no more war because war would not "pay." Now theorists think that this will be the last war. But as long as there remains anything worth fighting for, men will fight for it.

We are discovering that wars are now waged by entire peoples. The Balkan peoples knew this, tho those who believe that war can be carried on with "business as usual" sneer at them.

Before the Balkan War, the people did not talk. People who have trained themselves to conduct their military maneuvers in the inhuman cold and mud of Balkan winters have learned enough to keep their mouths shut.

The writer has seen several nations mobilize, each in its own characteristic way. But the Balkan mobilization was the enthusiastic assembly of men who deemed it not only a duty but a privilege to fight. Mobilization plans were embarrassed by a premature response to a rumor of impending mobilization. There was no "business as usual"—only the business of war for both men and women.

The Balkan peoples are not perfect. Their diplomacy is what centuries of Turkish oppression have made it. Their sanitary arrangements in the field were deplorable. But they possessed patriotism and training, and their armies had none of the complex needs of a more elaborate cvilization. These armies gave an example of courage and endurance impossible to surpass, and they took the field and kept it for months on a ration of *bread and water.* But the bread was honest, whole, wheat bread, not a mockery of alum and starch, for the Balkan peoples—the Bulgars in particular—do not take kindly to quackery in any form.

Amidst much that is shifting and uncertain, one thing looms out; whatever else may happen, Germany will emerge from this war in contact with an inexhaustible, exploitable mass of men and material to the east. The rest of the world should take judicial notice of this fact. The old order is dead. We start afresh after this. And we must abandon the time-honored game of evasion of the main issue, a little concession here, a small compromise there. Such policy will not retain men to whom opportunity beckons from other lands.

BALLISTICS

See also

ARTILLERY—FIRE

BOMBS—AERIAL—BALLISTICS OF

—Formulae

[Movement of Projectiles in the Air. By Dr. Godofredo Garcia. *Boletin del Ministerio de Guerra y Marina* (Peru), Feb, '18. 500 words. Formulæ.]

(A technical discussion of the movements of cylindro-ogival shells in the air. The author is a competent civil engineer. The original article shoud be read as the mathematical deductions do not admit satisfactory condensation.)

—Tables

[Extension of Siacci's General Ballistic Tables. By Angelo Ugo Beretta, Lieutenant of Artillery. *Rivista di Artiglieria e Genio,* Dec '17. 8 pages.]

(A continuation of Siacci's general tables to include values up to $u = 1$.)

BALLOONS

See also

DIRIGIBLES

FIELD ARTILLERY—FIRE CONTROL—AERONAUTIC

KITE BALLOONS

BANDS, Military

See also

MUSIC, MILITARY

BARBED WIRE ENTANGLEMENTS

See also

INFANTRY—INSTRUCTION AND TRAINING—GREAT BRITAIN (Article: "Tests of Military Efficiency in England)

BATH TRAINS

[Bath, Disinfection Trains and Field Laundries of the Austro-Hungarian Army. By Col. J. H. Ford, M.C., U.S.A. *Military Surgeon,* Oct, '17. 1800 words. Illustrated.]

The conditions under which men fought on the eastern front were such that facilities for bathing and keeping the body free from vermin were quite unsatisfactory. To ameliorate these conditions ten bath and disinfection trains (*Badezuge*) were organized. These proceeded to points near the front most accessible to the troops. They remained at such points about two days, the troops visiting them by roster.

The train consisted of nineteen cars and two engines, one for traction purposes, the other to pump water and develop steam to heat bath water or to fill the sterilizing chambers. Two cars were used for the personnel; five carried supplies, arranged on broad shelves along the sides. The supplies included complete outfits of clean clothing for use of the bathers while their own clothes were being disinfected. There were two tank cars, each with a capacity of 75,000 liters. Together, they held enough water to supply the train for two days. Each tank was boarded over, two doors being left in the cover. One of these doors gave access to the tank; the other was above the steam gauge, the thermometer and the stop cock which regulated the flow of water and steam.

Three specially built cars were used for disinfecting purposes. Each consisted of two chambers made of sheet iron, and airtight to pressure of ten atmospheres. Clothing was hung on hooks on the ceilings and walls.

BATH TRAINS—Continued

In one car underclothing was disinfected for half an hour by steam at 103° C. Leather goods and all other articles were disinfected for five hours in the other two cars.

The bathing section consisted of five cars. In the middle of this section was a long car in which sixty men could undress at a time. They left all their effects here, fastened in loosely woven sacks numbered to correspond to tags which each man retained. The bathers now separated into two equal sections, one proceeding into the bathing car ahead, the other into that in rear. Each of these cars had a 5000 liter tank on the roof and was equipped with thirty showers, each supplying 25 liters of water in five minutes—the time allowed for a bath. Soap and a towel were placed conveniently near each shower head. The floors were covered by wooden gratings. Gutters at the sides of the car collected the water, which was discharged from a scupper in each corner.

At the end of five minutes the bathers went into the end cars of the bathing section. Here, on two benches extending the entire length of the car, were laid out all the clothing needed by each man. These articles were worn until the man's own clothing was returned about six hours later.

Usually from 1400 to 2000 men bathed daily, but the number was at times increased to 3600. The personnel of the train consisted of one second lieutenant, seventeen operatives, and a train crew of six.

Field Laundries

The first field laundries of the Austrian army were imported from Germany early in the war. The German field laundry, consisting of two automobiles and two tenders, proved to be too elaborate for the purposes of the Austrians. Smaller units were therefore devised. These consisted of one automobile and a trailer. On the platform of the latter were mounted a mangle and a centrifugal drying machine, which could handle in one day about 1200 kg. of linen. The trailer also carried a movable engine of about 15 horsepower, a steam pump and a belt gearing shaft. The steam pump supplied steam to the water vessels, to the kettle boiling linen, and to the drying chamber. The top of this tender was constructed in the shape of a box, with double wooden walls, having an insulating layer in the middle. These walls could be removed and used for the construction of the drying chamber. The motor car carried the frame work of the drying chamber, the wings forming its side walls, tent material, and a supply of soap.

The tender was drawn by the motor car to some suitable place, the machines and apparatus were unloaded and set up and the drying chamber was erected by the use of the side walls from the tender and the frame and wings from the motor car. Finally the whole plant was covered by a tent. The drying chamber had a heating surface of about 72 square meters and dried 100 kg. of linen an hour. The condensed water from the drying chamber was carried to the filling reservoir for the engines. Vitiated air was removed by fans.

When the laundry was established the automobile was used to transport the clothes. The loading of the plant preparatory to following the movement of troops required from six to eight hours. The personnel consisted of a Landsturm officer and twenty-two men, including a chauffeur, an engineer and a mechanician. This was a highly mobile and satisfactory unit.

Another type of mobile steam laundry was not provided with auto transportation. Steam was supplied from a boiler mounted on wheels, which could furnish power for its own movement. The other parts of the unit were shipped by rail when camp was moved. They consisted of a pump, two cylindrical mangles, two centrifugal drying machines, a heavy canvas drying chamber about seven feet each dimension, a steel frame work to support tentage to cover the plant, a tent for this purpose (seldom used), a box tank 6½ by 4½ by 2½ feet supported by the steel frame, four sewing machines and six tents ten feet square. This laundry was sometimes operated in conjunction with a bath train but more often was independent. Its capacity was about 6000 pieces per day.

The personnel consisted of one lieutenant and five men. Repairs to the clothing washed were made by four seamstresses hired locally. This laundry proved of great value and a number were constructed and used.

BAYONET

See also

INFANTRY—ARMS—BAYONET

—Instruction and Training

[The Bayonet Dummy. By Major Jennings C. Wise, 318 Infantry, N. A. *Infantry Jour.*, Jan, '18. 1300 words. 3 photographs.]

A detailed description of the construction of a dummy to be used in bayonet instruction. The dummy is so attached to a base that it falls backward when struck, and is pulled back to the upright position by heavy springs when the bayonet is withdrawn. The base is mounted on castors, permitting great variety of bayonet exercises, several of which are described in this article.

[The Lessons of the World War. By Maj. J. Bartunek. *Schweiz. Monatschrift aller Waffen*, July, '17. 1600 words.]

After sufficient training in bayonet fighting, the soldier is given combat training in pairs and in groups. He must learn to attack impetuously and accurately, and to take advantage of any opening. On the defensive he must be active and prepared to pass to the offensive at the earliest opportunity. The German and French regulations made slight mention of this combat training, but the Austro-Hungarian regulations of 1914 prescribed it in detail. One difficulty is that, in training, the soldier is apt to thrust blindly, without regard for his opponent's weapon, whereas in actual combat he is driven to the defensive by his adversary's threatening bayonet. In order to simulate service conditions, and instill correct principles the Austro-Hungarian regulations require an umpire to be stationed behind each combatant, whose duty it is

to remove the soldier when he receives a disabling blow. The umpire, in order to prevent the "disabled" soldier from avenging the blow by rushing his adversary, is required to throw his arm around the soldier's neck, cut off his breath, and drag him to his knees.

Experience has shown that in this sort of bayonet combat the attacker is usually the loser, and this has been the usual result on the Italian front in actual war. The reason is that the attacker has spent his energy in the advance to the hostile trenches, while the defender is fresh. This goes to show the importance, in hand-to-hand fighting, of physical and moral strength, which can be gained only from years of military training and discipline. European troops so trained will not allow themselves to be bluffed by the murderous frenzy displayed by Asiatic and African troops in such combats.

Good results cannot be expected in bayonet fighting without long training. If time is not available, the defects can be minimized if hand-to-hand combat has been practiced in the schools. Similarly, athletic and rifle clubs should organize bayonet contests for prizes. The throwing of hand grenades should also be made a national sport. Among the troops at the front, prize contests should be organized behind the lines.

The length of the present war has required the use of reserve troops with only slight training. As they are unaccustomed to the bayonet, officers sometimes permit them to use clubs shaped like axes or studded with nails. These weapons produce in the wielder an impulsive spirit of attack, but are open to the objection that they cannot be used as firearms.

BELGIUM

—Army—Artillery

See

FIELD ARTILLERY—BELGIUM

—History

See also

EUROPEAN WAR

—Military Conditions

See

PRESS CENSORSHIP—BELGIUM

—Military Topography of

See also

EUROPEAN WAR—WESTERN THEATER

—Munitions—Manufacturing Facilities of

See

MUNITIONS—MANUFACTURING FACILITIES FOR—BELGIUM

—Neutrality of

[The Chiefs of the Belgian General Staff and the Preservation of Neutrality. By Maj. W. Marsily. *Schweiz. Monatschrift f. Offiziere aller Waffen.* Oct, '17. 2200 words. 1 map. (Conclusion).]

The *Echo Belge* points out that if any Belgian chief of the General Staff had entertained preconceived ideas as to the rôle of the Belgian army in a war between the guaranty powers, this would have been manifested in the exercises given out to his associates for solution, especially since he directed the exercises of the War School and acted as chief umpire of the "Great Work." The strict impartiality toward the neighbors of the kingdom maintained at these exercises is a guaranty that the responsible military leaders maintained the same atitude in their other work. A still clearer indication is found in the conduct of the General Staff Trip which was directly led by the Chief of the General Staff. This problem was carried out by the division staffs and those of the cavalry. The Chief had full opportunity to impress his views and doctrines on the participants, as the problems were not public. We have compiled a list of these exercises since 1897. There may be slight errors, as we have had to rely on the recollections of participants. The records have remained in Brussels. However, this fact helps our contention; the Germans have the opportunity to refute our arguments from the records if they can.

The following list comprises the problems of the General Staff Trips for the 17 years preceding the war. As there were no exercises in 1900, 1905, and 1912, there were 14 exercises under five chiefs. In seven, France was supposed to be the enemy; in six, Germany; in one France and England combined. The same impartiality appears if we consider the problems of each of the five chiefs. It is clear that the activity of each of these chiefs was devoted to preparing the Belgian army for service against attack from whatever opponent.

The problems were as follows: I. Leadership of Lt.-Gen. Renard. 1897. French army invades southern Belgium to attack the German right wing, and sends a flank detachment against the Belgian army near Rochefort. 1898. Similar invasion by German army against France; Belgians defend in vicinity of Marche-Champlon and St. Hubert. 1899. French army invades Belgium to attack Germany. Belgians defend near Ellezelles. II. Leadership of Lt.-Gen. Chapelie. 1901. French army, in war with Germany, violates Belgian neutrality. Belgians defend north of the Semois. 1902. Germans violate neutrality and march toward Flanders. Defense in Luxemburg Province. 1903. Situation similar; battle near Lierneux. 1904. French army of invasion moves against Namur. III. Leadership of Lt.-Gen. Ducarne. 1906. German army of invasion moves on Antwerp. 1907. French troops advance thru the Grand Duchy of Luxemburg and Luxemburg Province against the German border. Belgian defense between Longlier and Juseret. 1908. German troops move thru southeast Belgium against France, and seize a position east of the Ourthe. Belgians attack. 1909. French troops move thru southeast Belgium against Germany; flank detachments hold defensive position in Namur province against Belgian attack. 1910. English troops seize the coast from Ostend to Nieuport and move forward to Thourout. Belgians attack, leaving one cavalry division to observe the French, whose attitude is threatening. IV. Leadership of Lt.-Gen. Jungbluth. 1911. French army invades from the line Lille-Maubeuge. Belgians defend in vicinity of Enghien and Saintes. V. Leadership of Lt.-Gen. De Ceuninck. Germans cross the Meuse below Liege. Belgians defend near Huy.

BENZ MOTOR

[The 230 Hp. Benz Aero Engine. *Aerial Age Weekly*, Jan 28, '18. 1300 words. Illustrated.]

The following detailed description of the 230 hp. Benz engine is based on information courteously placed at our disposal by officials of the British Air Board.

Following the usual German aero engine practice, the 230 hp. Benz is of the six-cylinder vertical water-cooled type. Each separate cylinder is bolted to the crank case by long bolts and studs, which pass thru the crank chamber top half and secure the crankshaft bearings between the top and bottom halves of the crank chamber. Two inlet and two exhaust valves are fitted in the head of each cylinder. The pistons are of cast iron, fitted with three exceptionally wide rings, and the piston heads, following usual Benz practice, are supported by conical steel forgings riveted and welded to the piston crown, which bear on the center portion of the gudgeon pins thru slots cut in the connecting rod small ends. The lubrication of the crankshaft and connecting-rod bearings is effected by a very neatly designed gear pump working in an auxiliary oil reservoir formed in the bottom of the air-cooled base chamber. An oil-sealed petrol pump of interesting design supplies petrol to the carburetors in conjunction with a supplementary pressure reservoir enclosed in the main petrol tank.

Except for the steel water jackets, the cylinders are made entirely of cast iron. The bore of the cylinders is 144 mm. and the thickness of the cylinder walls tapers from 5.5 mm. at the base flanges to 6.5 mm. at the top of the cylinder barrels. The water spaces formed in the cylinder-heads and the cooling of the valve pockets are well carried out. Dished plates are welded in position in the water space above the crown of each cylinder to deflect the flow of water on to the exhaust valve pockets. The total weight of each cylinder complete with valves, valve springs and valve rocker-supports equals 44.25 pounds.

The pistons, with the exception of the small conical pillars, are made entirely of cast iron and weigh 7.62 pounds each, complete with rings and gudgeon pins. Three rings are provided above the gudgeon pin, the lower one being a scraper ring. The gudgeon pins are 38 mm. diameter, and are bored 30 mm. inside diameter. The very clean design of the tubular connecting rods is apparent in the photographic views. The six-throw crankshaft runs on seven plain bearings, and weighs 109.25 pounds, including the propeller boss. The cranks are, of course, set at 120 degrees and the diameter of all the journals is 62 mm., whilst that of the crankpins is 60 mm.

[The 230 Hp. Benz Aero Engine. (Continued.) *Aerial Age Weekly*, Feb 11, '18. 1650 words. Illustrated.]

The hollow camshafts each run in three plain phosphor-bronze bearings, and are arranged inside the top half of the crank chamber. The method of cooling the interior of the crank chamber and sump indicates the fact that this matter has received most careful consideration in design.

In the top half of the crank case six of the seven main bearing houses are cast so that the webs form air passages transversely across the engine. The bottom half of the crank chamber is extended to form an oil sump and is of unusual design. Breathers are also fitted into the top half of the crank chamber.

Two separate carburetors are fitted each feeding three cylinders. At full throttle most of the air is taken thru the air ports in the throttle above the jets. When the throttle is closed for slow running, the main jet is completely cut off and all the air is taken thru the passage containing the pilot jet. The slow running of the engine is very good. No compensating arrangement is fitted for high altitude control. The R.A.F. test report computes the petrol consumption at 150 pints per hour, equalling 0.65 per brake horsepower hour. The connections between the flanged bends of the induction pipes and the cylinders, and also between the bottom ends of the induction pipes and the carburetors, are made with rubber ring joints secured by wide band clips.

The crankshaft journals and crankpins are bored for lubrication, the webs being drilled with communicating holes in the usual manner. A double-thrust ball race, 120 mm. diameter, is fitted at the front end of the crankshaft behind the front flange, to which the propeller hub is bolted. Fitted to the rear end of the crankshaft is a friction clutch for operating the wireless drive, which is designed so that the driving brake-shoes of the clutch can be thrown in or out of engagement with the driving pulley from the pilot's seat thru the action of two wedges which operate the friction shoes thru ball-ended levers.

The twin inlet and exhaust valves work vertically in the cylinder heads, and are operated by rockers mounted on ball-bearings, carried by supports screwed into the cylinder head. The dimensions of both the inlet and exhaust valves are the same, each valve weighing 1.25 pounds. The lift of the inlet valves equals 0.465 in., and lift of the exhaust valve equals 0.443 in. Clearance of inlet tappet equals 0.009 in., exhaust 0.015 in.

BOMB-PROOFS

See

ENTRENCHMENTS—BOMB PROOFS

BOMBS

See also

GRENADES

—Aerial

See also

AERONAUTICS—BOMBS AND BOMB DROPPING

DIRIGIBLES

[Aircraft Bombs. By Justin Lauvergne. *Aviation*, Jan 1, '18. 1050 words. Illustrated.]

The missiles which were dropped from aircraft in the early days of the Great War were, for the greater part, bombs and grenades of obsolete types which had been formerly employed in field warfare. Their action was rather uncertain and their manipulation was often fraught with considerable danger. A short time before

the war broke out, the Vickers Works of England had, however, patented two types of aircraft bombs which were provided with a safety device that prevented their premature or accidental explosion. In the first type Vickers bomb, the firing charge is held remote from the explosive charge until after the launching, and means are provided to cause the bomb to explode at a previously determined distance from the ground or the target. The bomb is fitted with a "pilot" consisting of a metallic mass, which is suspended from the body of the bomb by a chain or wire; the tension of this pilot cord is increased by a parachute, which slows down the bomb's vertical speed. When the cord is entirely unwound, the spring of the percussion needle is, therefore, held in place only by the weight of the pilot, so that as soon as the latter strikes its objective the spring is released and drives the needle into the percussion cap of the firing charge, which in its turn acts on the explosive charge. In another type, the mass of the pilot is composed of a cartridge with its percussion fuse and cap, and a fuse takes the place of the cord. On striking the target, the cartridge sets fire to the fuse, and, this in its turn, sets fire to the detonating charge. In another type of bomb, the pilot consists of a rod, which is carried thru the body of the bomb in the longitudinal axis; a tail piece carries in the rear the firing charge and stabilizing fins. The rod rests in a suitable guide, which is locked when the bomb is inactive, but thru which it is permitted to slide when the lock is removed. The firing charge is thus kept far apart from the explosive charge, so that even an accidental discharge of the firing charge is not likely to endanger the crew. By operating the lever which releases the bomb the safety lock is automatically removed and, as the bomb gradually assumes a vertical position, the pilot rod slides forward, and carries the firing charge into the center of the explosive charge. A spring-loaded percussion needle then slides into a suitable aperture provided for it in the tail piece of the bomb and is ready for action. When the pilot rod hits the ground, the impact makes it slide back in its guide; the firing charge is thus brought in contact with the needle and the explosion follows. In the Kunkler bomb the safety device is based on the action of the centrifugal forces developed during the fall of the bomb. For this purpose the bomb is provided, at the rear, with an aerial propeller which imparts to the bomb a rotary motion. As soon as the centrifugal force acquires a certain magnitude, the masses will overcome the force of the springs and move toward the periphery of the bomb, thus freeing the firing charge which is then held in place only by two clamps. On striking the ground the clamps will give way and drive the firing charge into the percussion needle.

The Bergery-Derocle bomb, which has been described in *Schuss und Waffe*, is of the rebounding type. This bomb consists of an external casing which is enclosed on its lower end and houses the body of the bomb proper. On striking the ground the case, which carries the firing charge, acts like a mortar and imparts to the bomb proper a force opposite to that of its trajectory, causing it to rebound upon striking the target. The external and internal portions of the bomb are kept in their relative position, up to the moment the impact occurs, by suitable catches. When the outer case strikes the ground its motion is annulled, but the bomb proper, having a considerable inertia, will tend to continue on its path. The force thus generated unlocks the catches and drives the bomb with its firing pin against the detonating charge contained in the outer case, which then shoots out the bomb proper as a projectile is fired from a gun.

[Aerial Bombardments. By S. *Memorial de Artilleria,* May, '18. 50 words.]

Below is the total weight of bombs dropped from Allied airplanes during the year 1917.

	Weight of Bombs Dropped, Kgs.	
Month, 1917	By day	By Night
January		15,350
February		30,935
March	720	25,683
April	400	22,786
May	7,772	76,223
June	4,859	55,617
July	8,018	58,084
August	9,394	41,421
September	29,223	137,145
October	18,455	56,891
November	9,087	7,560
December	36,772	21,484
Totals	124,700	549,179
		673,879

—Aerial—Ballistics of

[Bomb-Throwing from Aircraft and Ballistics of Aircraft-Bombs. *Schweiz Zeitschrift f. Art. u. Genie,* Sept., '17. 2300 words. 1 fig.]

All air raids, whether by airships or flying craft, have shown that as a rule the military damage has been much less than the destruction of matériel and of lives which have no direct connection with the war. Obviously the flier does not deliberately drop his bombs so as to miss military works. The cause is the fact that bomb-throwing from aircraft depends more on chance than on intention and skill. Neither airship nor flying craft can maintain itself stationary, and in addition the bomb is affected by the resistance of the air and the direction of the wind.

The ballistic conditions are: 1. Gravity; 2. The velocity of the aircraft; 3. The resistance of the air; 4. The velocity of the wind; 5. the form of the missile. Gravity is the principal propelling force, as the bomb is not propelled by an explosion. The velocity of the aircraft gives direction to the bomb, and imparts an equal initial horizontal component to the velocity of the bomb. The resistance of the air imparts a negative acceleration. The velocity of the wind may either accelerate or retard the bomb, and may cause it to deviate to one side. The form of the bomb can increase or diminish the effect of the air and wind.

Neglecting the air and wind, the trajectory would be a parabola, due to the constant horizontal component, and the constantly increasing vertical component of the velocity. The bomb must be released at a point

BOMBS—Continued

such that it will reach the target when the aircraft arrives directly over the target. This consideration determines the angle which the bore of the tube must make with the line of travel of the aircraft, and the bomb must be released when the cross-hairs of the tube are on the target. The angle varies directly as the altitude and indirectly as the velocity of the aircraft.

The resistance of the air produces a horizontal retardation, and in addition it alters the vertical acceleration, which gradually reduces with the increasing velocity until the resistance has an effect equal to that of gravity. The trajectory is thus a ballistic curve instead of a parabola. The ultimate elimination of the horizontal component of the velocity, and the reduction of the vertical acceleration to zero, finally produce a straight fall in a vertical line, with constant velocity. If the exact effect of the resistance of the air is known, the angle of depression of the tube may be computed for each height and velocity. The bomb-thrower must then find the point over which the pilot must fly at the instant when the cross-hairs are on the target. Obviously better results are obtained on a target of great linear dimension in the direction of travel than on other targets.

An additional difficulty is caused by the fact that the aircraft, in taking a curve, tilts like the wheel of a cyclist who travels on an arc. As a result the shot-group on the target takes the form of an ellipse with the major axis in the direction of travel of the aircraft.

Leaving out of consideration the effects of rain, fog, and night, the wind has an uncontrollable effect. Head and rear winds diminish or increase the velocity of flight. Cross winds alter the direction in accordance with the law of the parallelogram of forces. The direction and velocity of the wind may differ in the various strata thru which the bomb must pass.

For the foregoing reasons small objects cannot be picked out as targets. The bomb-thrower must take whole cities and positions for his targets, hoping that among the objects damaged there will be points of military importance. The airships have better success than the airplanes, because they can reduce their velocity almost to zero before the discharge, and can therefore throw several bombs in quick succession, whereas airplanes must aim each shot separately.

The firing data is determined as follows: A body falling in vacuo from a height of 1000 meters takes about 14 seconds to fall. The bomb must therefore be thrown 14 seconds earlier than the aircraft arrives vertically over the target. Since an aircraft averages 40 meters per second, the bomb must be thrown 560 meters in advance of the target. This distance is increased with the height above the target and with the velocity of the aircraft. As firing by distance involves the observation of a second point on the terrain, it is simpler to reckon the angle of the tube. Accuracy depends on an accurate reckoning of the height above the target and of the velocity of the aircraft. The height of the craft above sea-level is determined from a barometer, which is uncertain. From this is deducted the height of the target above sea-level, taken from a map. The velocity can be determined by observing the time of flight from one point to another, whose distance is found from the map. If the distance is not known, the velocity can be determined by observing the angle at which one point is seen when the craft is over the other point, and the time of travel between the two points. As the aircraft moves an appreciable distance during the observation, it is more accurate to take two observations on the same point, and note the two angles and the intervening time. The other factor in determining the velocity is the height above the target. From this height and the velocity the angle for the tube can be determined. Tables are, of course, used instead of actual computation.

BOURESCHES, Capture of

[Harrying the Hun at Bouresches. By F. E. Evans; Maj. U.S.M.C. *Marines Magazine*, Sept, '18. 2500 words.]

(A letter from the above officer to Maj.-Gen. G. Barnett, U.S.M.C., giving, in considerable detail, the capture of Belleau Wood and Bouresches by the Marines.)

BRAZIL

—Army—Schools and Training

[Recruiting of Officers for the Brazilian Army. By Col. Juan Garcia y Gomez Caminero. *La Guerra y su Preparación*, Oct, '17. 2800 words.]

Officers of the Active Army

Officers of the active army must be graduates of both the Military Academy and the Practical School for the Army. Very few countries have as general a military instruction for young men as Brazil. All schools are required to have a military instructor, and the military schools of Rio Janeiro, Puerto Alegre, and Barbacena are paid and protected by the government. A group of officers and non-commissioned officers at each school prepare the pupils for entrance into the Military Academy and train others for the pursuit of civil careers.

Graduation from one of the military schools is a condition necessary for admittance to the Military Academy. These military schools are really preparatory schools for the Academy. They are wonderfully well organized and conducted. The school at Rio Janeiro is a model of its kind.

Military Colleges

In these places the sons of army and navy officers and of soldiers killed in battle, as well as orphans and grandchildren of military men, are educated gratis. A certain percentage of children whose parents are in civil life are admitted each year on a tuition fee of 2000 pesetas per annum.

The course lasts five years. The instruction is under army officers who organize the pupils into four battalions. Only boys between the ages of 10 and 13 years are admitted.

Military Academy

This place is destined to graduate candidates for the Practical School of the Army. Candidates for the Military Academy must be unmarried men between 17 and 21 years of age, in good health and with a

good conduct record. They must have gone thru the course at the Military College and have served six months in some branch of the service, or be able to present a reservist's certificate.

Graduates from military colleges are not required to take an entrance examination. Others take an examination in languages, mathematics, chemistry and elementary mechanics.

The theoretical course is from April to November. December to March are devoted to practical drills. Cadets are organized into companies of 100. The course consists of two years' fundamental work—which is the same for everybody—followed by four special courses, two courses of one year each for Infantry and Cavalry, and of two years each for Artillery and Engineers.

Fundamental Course

The first year course consists of theoretical work in analytical geometry, differential and analytical calculus, perspective, shade and shadows, principles of army organization, tactics, strategy, military history of Brazil, and a general law course.. The practical exercises comprise drills, equitation, target practice and modern language conversation.

The second year theoretical course includes chemistry, mechanics, military aeronautics, topography, and military hygiene, while the practical course remains the same as the first year.

Special Courses

The Infantry students take a theoretical course in tactics, infantry organization, small arms and machine guns, ordnance, ballistics and explosives, and field and permanent fortification. The practical course consists of infantry drill, topography, target practice, fencing and language conversation.

The Cavalry students take a similar course, with hippology and equitation in addition.

The Artillery special course is divided into two years. The first year course is similar to the above courses as applied to artillery, while the second year is devoted to mechanical study and training in fortification, attack of fortified places, metallurgy, electricity and use of explosives.

The Engineer course specializes in construction of all three sorts: Military, architectural, and sanitary. Hydraulics and strength of construction materials are also studied, with the usual equitation and language conversation as practical work.

The second year studies are geodesy, astronomy, field fortification, motor transportation, and machinery. The practical work consists of topography, geodesy, fortification, telephony, telegraphy, photography and bridge construction, with the usual language conversation.

The Practical School for the Army

This school has a double object; first to complete the studies of the Military Academy, and secondly, the following:

1. To carry out experiments and work in firing and armaments ordered by the Minister of War.
2. Study of methods of fire.
3. Study of tactical regulations.
4. Study of war progress in foreign countries.
5. To organize annual conferences on the above subjects.

The pupils are organized into companies of 100 men. They are interned at the school during the period of their attendance. The course is divided into two semesters—from April to September, and from October to March. (The author gives courses in detail.)

General Staff School

This school is situated in Rio de Janeiro, and its object is to prepare captains and lieutenants for General Staff work. The course is for three years and is essentially the completion of the studies given in all the lower military schools. The last year is devoted entirely to practical work in the field.

Reserve Officers

Reserve officers are appointed by the president from civil life; engineer officers being selected from civil engineers, artillery officers from civil, geographical engineers or scholars, and cavalrymen from those who demonstrate an aptitude for this branch. These officers are in the National Guard, and hold commissions from colonel down to ensign. They are paid by the state from 760 pesetas down to 100 pesetas according to their rank.

In 1913 Brazil had a total of 28,000 officers of all arms available for duty.

BRIDGES, Military

See also

River crossings

[The Calculation of Improvised Bridges for Artillery and Baggage Trains. By Major Mascarucci. Translated from the Italian. *Revista Militar* (Argentina), Oct, '17. 6700 words. 4 graphs.]

(A technical article on the construction of field bridges that does not permit of condensation.)

—Bridge Troops—Instruction and Training

See also

Engineers—Instruction and training (Article: "Bridge Training of a Battalion of Mounted Engineers")

[Bridge School of the First Engineer Regiment, 1917. By J. R. y. J. P. *Mem. de Ingenieros,* May, '18. 8000 words. Illustrations.]

The writer considers that one year at least is needed for the proper instruction of a recruit in all the details of bridge building, so that he may do the work or else properly direct other men on the work. This includes ponton, trestle, and improvised bridges.

The ponton period is largely devoted to training in handling the boats in bad currents. (This agrees with standard practice in the American Army.) In all the work, both practical and theoretical, it is considered desirable to mix the recruits with old soldiers to as large an extent as possible, in order to speed up the training of the recruit. At the same time an effort is made to avoid loss of time by the older soldiers in doing work with which they are already thoroly familiar. No new methods of work are brought out which are

BRIDGES, Military—Continued

believed to be of importance for the American Army.

The theoretical instruction for the men of more intelligence is largely occupied with problems involving bridges which are never constructed. The bridge site is looked over carefully and a limited time is given for the selection of the type of bridge, the location of the material, and an estimate of the tools, labor and time needed for the job. The method of instruction in general follows the practice in the American Army.

[Advance Guard Bridge Equipage. By Gen. Jose Marva y Mayer. *Mem. de Ingenieros,* July and Aug, '18. 4500 words. Illustrations and figures.]

In all well organized armies it has been understood that advance guard bridge equipage was essential to enable light forces to cross rapidly and certainly any small streams or waterways which might intervene between the forces and the objective. At the present time this is believed to be even more essential than in the past on account of the size of modern armies and on account of the greater effort to move in the field on an accurate time schedule. Keeping this in mind, it is easy to see the importance to a division of bridge equipage with the advance guard which can be placed across small obstacles rapidly enough to prevent the march of the main body from being interrupted. For this purpose, we can not rely on improvised bridge material, for its use is too slow, even if it could be found on the ground where needed; we must carry with us on the march bridge material already cut and fitted and which can be rapidly thrown together across small obstacles. The first solution of this problem was to give each company of divisional engineers the necessary trestles, boats, and flooring for 30 to 40 meters of bridge, all made standardized material.

The ponton bridge will obviously not be satisfactory for shallow streams with rocky bottoms, deep ravines, and streams with high, steep banks. This fact has led the Spanish authorities to develop a new type of bridge train for advance guard use which eliminates the ponton, using trestles thruout the bridge. This equipage is designed after the Danish and Birago types, the trestles being very similar to the Birago trestles in use by the United States Army. This type of bridge also enables the wagons to be loaded more lightly, as the wooden boats are very difficult to transport rapidly. Wood is used wherever possible in the construction of these bridges. The chief innovation developed in the bridge itself as compared with the American type of Birago trestle bridge is the method of placing these trestles. The bridge is constructed by the "Successive bay" method, each trestle being placed after the bridge has been completed up to the preceding trestle. All the work is done from the floor of the bridge, eliminating the necessity for men working in water or mud.

A counterweight working on rollers is provided and run out onto the last completed bay of the bridge, bearing a triangular frame, approximately a right-angled triangle, the right angle vertex being fastened to the outer end of the counterweight. The trestle is then put together in an upright position, the cap resting on the floor of the bridge and the legs on each side of the floor. The outer end of the triangular frame (one of the acute angle vertices) is fastened to the cap of the trestle and the triangle is then rotated about the right angle vertex until the trestle is lifted clear of the flooring. The whole counterweight is then run forward on the rollers until the triangle can be dropped forward and the trestle dropped into position. The triangle is controlled by means of a rope which is fastened to the inner or third vertex of the triangle, the rope then running thru a snatchblock at the rear end of the counterweight. At an official test of the new equipage the trestles were placed by this means in six or seven minutes each, using partially trained engineer soldiers for labor.

BROWNING MACHINE GUN

[Test of Browning Machine Rifle. *Army & Navy Jour.,* Mar 2, '18. 2800 words.]

A bulletin issued by the Committee on Public Information on Feb 27, stated to be on authority of the Ordnance Department, gives the following facts concerning the Browning machine guns. The Browning machine rifle, model of 1918, so-called "light Browning rifle," and the Browning machine gun, heavy type, model of 1918, so-called "Browning heavy machine gun," the machine guns adopted for use by the U. S. Army, are the inventions of John M. Browning, distinguished firearm designer, inventor of several Winchester rifles, automatic pistols, repeating rifles, the Colt machine gun which was adopted by the U. S. Army and Navy, and numerous other arms. The Colt automatic pistol is his invention and was adopted by the U. S. Army, Navy and National Guard in 1911. The Browning machine rifle is an air-cooled, gas-operated gun, weighing fifteen pounds and resembling in appearance the ordinary service rifle. It may be fired from the shoulder, the rifleman finding his target over sights identical with those used on the new U. S. rifle, model of 1917, or from the hip, the rifleman finding his target by his general sense of direction, the latter being a knack quickly acquired thru practice.

Gas-Operated Mechanism

The principle of gas operation is simple. The gun is cocked with an easily operated handle for the first shot. The bullet is expelled by gases which exert a maximum pressure of 50,000 pounds to the square inch (ordinary service cartridge such as is used in the U. S. rifle, model of 1917, and the Springfield). A small portion of this powder gas is taken off by the gun mechanism to act as power to operate the gun automatically. A cartridge discharged from this gun has approximately the same power as that fired from the U. S. rifle, model of 1917, or from a Springfield service rifle. Cartridges are fired from a detachable magazine containing twenty, or for special purposes forty, service cartridges. The magazine may be detached by merely pressing a button and a new magazine attached by one motion, this changing operation requiring about two and one-half seconds.

The gun may be operated as an automatic or as a semi-automatic arm. There is a lever at the easy disposal of the rifleman. By putting the lever in the

first position the gun is made to fire single shots by trigger release; by putting the lever in the second position the gun becomes automatic and will fire twenty shots in from two and a half to three seconds; the third lever position is the "safe" or locking device. The designer intended the gun to be used more as a semi-automatic than as an automatic arm.

Powder gases create terrific heat, sometimes developing the destructive temperature of 4000 degrees Fahrenheit. An air-cooled automatic gun therefore has its limitations. The Browning rifle has open and very simple construction and cools remarkably quickly. The rifleman may fire 350 continuous shots from it without having to stop and cool the weapon.

The chief characteristic of the gun is its extreme simplicity of construction, rendering the manufacturing problem correspondingly simple. It has fewer than twenty principal parts and possesses the great advantage of standardization, being easily and quickly taken apart and reassembled by the ordinary soldier. From the manufacturing viewpoint the gun possesses great advantage as it may promptly be produced in large and increasing volume as shop machinery is multiplied and operating personnel developed. Used cartridges are ejected from the side of the gun, never crossing the sight of the rifleman, and coming out with sufficient force to clear themselves beyond his notice. A feature of the rifle is that the cocking handle remains stationary while the gun is in operation and is so arranged that it will in no way hamper the gunner, thus eliminating a danger common to many guns. The gunner may operate the gun at all times without aid. Only one tool, a small wrench, is needed to care for the gun, as most of the operations of taking it down and reassembling may be performed by use of a cartridge as a tool.

Tests by War Department Boards

This Browning rifle has met some remarkable tests by the War Department boards. A board test of a machine gun far exceeds any test that a gun might receive in service. Two of the features of a board test are applying corroding chemical to the gun to effect a rusting condition which could not possibly obtain while in the hands of a soldier, and the "dust test" in which sharp abrasive dust is blown into the mechanism from a bellows, creating a condition of the gun which would cause a soldier to meet court-martial charges were he to so neglect his weapon. Under these and other prescribed tests the Browning guns were successfully tried out.

The gun was then put thru an endurance test. In bursts of 500 or 1000 a total of 20,000 shots were fired, the gun being cooled between bursts. The total number of malfunctions in the 20,000 rounds was fifty, the majority of which were due to causes which have been remedied by the inventor since these tests and are eliminated from the rifle as it is now being manufactured.

The gunner carries approximately 120 rounds of ammunition in his belt or bandoleer and his two assistants carry 400 and 240 rounds respectively loaded in magazines. The loaded magazine weighs one pound and seven ounces. Thus it is possible for a gunner to go into battle with a supply of about 800 rounds of ammunition. Cartridges are stripped from clips into the magazines with ease, this operation requiring little time.

Because of its portability and its automatic and semi-automatic functions the Browning rifle possesses tactical possibilities of great importance. It permits troops to go forward in attack with tremendous advantage over adversaries who do not possess equally efficient automatic guns. When the gunner meets a detachment of the enemy he is able to take sure aim over the sights and from his shoulder, mow them down, with from twenty to forty shots expelled almost instantly, while he may use only single shots and conserve his ammunition if the enemy target is but one soldier. Effective use may be made of the gun in sweeping out trenches and in similar tactics. The tendency to demoralization among troops when they are confronted by attacking automatic guns is a well established fact.

Reports received from observers abroad indicate that the drift in the French army is decidedly towards increased use of automatic rifles of the more highly portable type, such as the Chauchat. According to Army officials the Browning rifle in many essential features, such as reliability of function, durability, lightness and handiness is superior to any other light machine gun, and in particular is supreme over any gun of similar type developed by the enemy.

The Heavy Type Browning Gun

The Browning machine gun, heavy type, model of 1918, is water-cooled and is operated by means of the power created by the recoil action. It is fed from a cotton belt which contains 250 rounds of service cartridges. The belts may be rapidly loaded by means of a machine which is a development of the one which Mr. Browning devised some twenty years ago in connection with the Colt gun. The most remarkable features of this heavier type of Browning gun, as revealed by the official tests, are its simplicity of construction, rendering manufacturing problems easy, and its great endurance. In the Government test 20,000 rounds were fired from this gun with only three stoppages, one due to a defective cartridge. In a further test firing was continued with the same gun to 39,000 shots, when the sear gave way. A duplicate gun fired 20,000 shots in forty-eight minutes and sixteen seconds, without a malfunction and with only three stoppages, these being due to defective cartridges. The gun weighs 34½ pounds, with the water jacket filled. It is fired from a tripod. It has great tactical value for such firing as overhead, indirect, barrage, defensive and similar uses.

In passing on this gun the testing board reported as follows: "The board is of the opinion that its lightness, simplicity, reliability of function and endurance in action are such as to make it superior to any other of the so-called heavy water-cooled type known to the board."

With certain modifications this gun is applicable to aviation service. When used for this purpose it is stripped of its water jacket and weighs 22½ pounds.

BULGARIA
—History
See also
BALKAN WARS
EUROPEAN WAR

BULLET-PROOF CLOTHING
See
BULLET-PROOF SHIELDS
HELMETS—ARMORED

BULLET-PROOF SHIELDS
—Portable

[The Latest Thing in German Sniper's Masks. *Popular Science,* Jan, '18. 200 words.]

The Canadians on the western front recently captured from the Germans a heavy metal mask which has attracted a great deal of attention. It is made of quarter-inch Krupp steel, and furnishes ample protection for a sniper lying prone, altho it is little larger than a man's head. A rectangular piece is cut from the lower right hand corner of the mask. This permits a rifle to be held to the shoulder in the natural position. The eye slits are set so far apart that only one at a time can be used. They have a peculiar sloping shape which conforms to the angle of the eye of the sniper as he turns his eyes from one side to the other within the mask.

BULLETS
—Manufacture

[Manufacture of Shrapnel Bullets. ,Cronica. *Memorial de Artilleria,* Nov, '17. 400 words.]

During the first few months of the war the bullets for French shrapnel and shrapnel bombs were manufactured by hand in small moulds which only had a capacity of 12 bullets. They were then cut and rolled. Under these conditions it required 12 people to make 260,000 bullets per day.

The supply became inadequate and the following process was introduced: An alloy of lead and antimony is made in gas crucibles. The slag is removed and the alloy is cast into 60 kg. cylindrical ingots. These ingots are placed in a hydraulic press and pressed out into wire form, each press making five wires at a time. These wires are wound on wooden bobbins as they come out of the press, each bobbin having a capacity of 1000 kgs.

Twelve wires are then fed into a hydraulic punch so that 12 lead spheres are punched out each time the punch actuates. (The upper and lower faces of each punch have 12 hemispherical dies which receive the cables.) The spheres are then placed in revolving barrels and rolled, which gives them a good smooth surface.

By this process 40 workmen can turn out between nine and ten million bullets in 20 hours of work.

CAMBRAI, Battle of

[Cambrai and Bourlon Hill. By Hilaire Belloc. *Land and Water,* Nov 29, '17. 4100 words. 4 sketches.]

On Nov 20 at dawn General Byng with the Third Army launched one of the most important offensives of the war against the sector of the "Hindenburg Line" covering the nodal point of Cambrai.

The essential features of the attack were (1) The use of a very large number of tanks in line; (2) their advance without any previous bombardment over firm, open and unspoilt country; (3) the success of the surprise thus effected and the consequent destruction of the very strong successive positions covering Cambrai.

The first day, Nov 20, was one of complete surprise, in which the enemy had not time to organize his resistance; but there began from the first news of the British success the most intense efforts at counter-concentration by the enemy. Troops were being hurried forward all Tuesday afternoon by all the routes which converge on Cambrai and the enemy began to dig in, especially just south of Bourlon Hill, the crux of the new positions. At the close of the operations on the 20th a great wedge had been thrust into the enemy's positions, the "Hindenburg Line" had been broken thru upon some seven miles of its course, and the last elements, the third line, reached in several places. The twenty-first, second, and third were marked by heavy counter-attacks, the enemy continuing to pour men down upon the threatened region. Nov 24 was taken up with the effort to occupy Bourlon Hill and wood and the corresponding enemy defenses. On Nov 25 Bourlon Hill was thoroly occupied, its crest secured, and the northern reverse side held also after two days of fluctuating and very heavy fighting.

This great obstacle and observation point was then in British hands and if it securely so remain the value of Cambrai is lost to the enemy. Cambrai is the knot of a complete road system and also of the main railway system of the enemy in this region. His loss of the power to pass his supply thru such a center would at the least entail the modification of his whole line for a great distance north and south of it.

[The Battle of Cambrai. By Hilaire Belloc. *Land and Water,* Dec 13, '17. 1500 words. 2 sketches.]

The battle of Cambrai, up to the moment of writing, has passed thru three phases.

(1) On Nov 20 the British Third Army under General Byng, broke the German front by an action of surprise including a new tactical use of the tanks, and formed a great salient in front of Cambrai about four miles deep, and some six or seven miles long. Further fighting gave the offensive possession of Bourlon Hill, the continued holding of which would destroy the value of Cambrai as the meeting point of the German communications upon this front.

(2) After the salient had been more or less stabilized and at points slightly reduced by local enemy action, but with Bourlon Hill still secure in British hands, the enemy upon Nov 30 attacked violently the northern and southern limbs of the salient in order to cut off the neck of the salient and destroy all the forces within it. This plan bade fair to succeed from the fact that the enemy effected a surprise against the southern arm of the salient, which he penetrated for about a thousand yards. But the pressure against the

northern arm was met with a determined resistance, his eruption upon the south was partly beaten back, and the encircling movement failed. Its result, however, when the very heavy fighting of this main counter-offensive died down, was to leave the salient with a boundary no longer tenable. After a second enemy effort on Dec 3, the third phase followed.

(3) On the night of the 4-5 of December, the British line was withdrawn, Bourlon Hill evacuated, and a retirement begun upon new positions. The new line has a solid hold upon the heights overlooking the Cambrai hollow. It is obviously strong in position, and its artificial strength must have been greatly consolidated in the last few days, while its trace is too flat to allow of any part of its being taken in reverse.

Meanwhile the value of Cambrai as a center of communications for the enemy has been restored, and the main object of the original advance is unattained.

The story as a whole is quite clearly one of a superior concentration. Unofficial estimates have suggested as many as 25 German divisions in action upon this front, and certainly there have been more than 20.

The main factor in the German success was the weight of numbers, and this in its turn leads back, as does everything that has happened during the last three months, to the débâcle in Russia.

The enemy, thru the latter developments of the Russian Revolution, has acquired for the first time in over two years a definite and increasing numerical superiority upon the Western front.

[Tactical and Professional Notes. Cambrai. By M. Roberts. *Military Historian and Economist*, Apr, '18. 1600 words.]

The interesting features of the British attack at Cambrai, Nov 20, 1917, are discussed under the following heads:

1. *The New German Scheme of Defense.* The German system was here complete, and consisted of a front zone lightly held and a deep zone strongly held and fortified. The British failed to solve the tactical problem presented by this disposition.

2. *The English Failure to Solve the Tactical Problem.* The fundamental cause of the partial failure was that the army was improvised and hastily trained, well fitted for trench warfare where practically all conditions can be foreseen, but unfitted to cope with a situation presenting novel features. Things went smoothly enough in the first zone, but deeper penetration brought difficulties. Dash and fighting spirit were substituted for co-ordinated action, and the situation that developed presented a fine opportunity for strong counter-strokes.

3. *The Failure of the Public to Understand the Event.*—The great trouble is that the public does not understand that the army is trained only for trench warfare, but relies upon a notion that nationality may be substituted for training. Nor does the public realize that trained officers are needed to produce trained men.

4. *Its Reaction on the High Command.*—The public outcry in England against the High Command was grossly unjust. Cambrai helped to cause the retirement of Sir William Robertson from the post of Chief of Staff, and other changes may follow. There seems to be reason, however, for supposing that the British High Command is beginning to realize the misuse that has been made in the past two years of the British military resources. It has been evident to a serious military student that the time when numbers and initiative favored the Allies was being frittered away. Now Germany is able to turn from the defensive to the offensive, and the consciousness sinks into the British command of the fundamental error in the conduct of operations up to the present moment.

5. *The British Conception of the Western Front.*—Whatever may have been hoped for the Cambrai offensive, the penetration was actually quite as deep as could have been expected considering the front attacked. Recent experience indicates 2000 to 4000 yards as a reasonable penetration on a front of 10,000 to 12,000 yards.

6. *The Artillery Factor.*—Cambrai raises the question of whether the artillery has not been unduly developed with respect to the infantry as a question of man power. This question may require the data which will only be available at the end of the war for a complete answer. But it would be easy to fall into the error of too large increases in the artillery, thus reducing the effective strength of the infantry. As an instance one proposition advanced before the Senate Committee involved an artillery personnel of two and a half million men. In such a case, where would the infantry come from? The German General Staff has undoubtedly given this subject careful consideration.

CAMOUFLAGE

[Artillery Camouflage on the Western Front. By J. Whitney-Gaston. *Aerial Age Weekly*, Dec 17, '17. 1210 words. Illustrated.]

It is axiomatic for an artillery officer to hide all traces of his men and position. Hence has arisen a system of camouflage. The material sometimes employed is "Saffia," but it has the disadvantage of being slightly transparent at a distance. Linen cut into various forms and smeared with paint is also used but the paint ignites readily from spontaneous combustion. A large strip of linen, altho in color harmony with the surroundings, often reflects so much light as to be quite evident in a photograph. Flat surfaces are dangerous. Branches of trees thrown carelessly over a trench show plainly in a photograph, whereas the betraying edges are hidden if they are set upright. A path is a dangerous indication. Telephone wires often show because the men making repairs leave a path.

Photographs of the enemy lines taken from day to day show infinitesimal changes. Photographs taken of a disguised position in a woods, compared with previous photographs, show an effect of something having grown quickly. The paths used constantly should never show the true direction to the post or position. One has to study the German system of offense and defense to anticipate where machine guns will be found in photographs. Openings in the countless barriers of barbed wire must be disguised against the all-seeing

CAMOUFLAGE—Continued

camera. Wherever a switch shows in a photograph it is safe to assume that it is important to the enemy. Hence a good dose of shell. Aerial observation of necessity must be rapid because of the many obvious perils. The fact that the target cannot be seen by the range finder is not so important, because the military map drawn up from day to day gives accurate measurements of distance and direction. When once the airplane observes how the shots are falling he can send in directions. Owing to his great height it is not necessary to be in a vertical plane of observation, so time and safety are assured. Communication from the airplane is by radio. The antennae of the receiver on earth should be far from any crest or cover of earth which would intercept the waves from the aerial apparatus. The batteries communicate with the airplanes by means of signals made with strips of canvas. In working with aerial observers time must be saved, so the gun pointers must be thoroly trained.

—Personal Make-up

[Recent Artifices of Modern War. Reprint from *Risorgimento. Revista Militar* (Argentina), Sept, '17. 1200 words.]

"Make up" has become as important for English soldiers in this war as it has always been for actors on the stage. Thousands of soldiers on the western front have their faces painted in various colors and forms in order to facilitate concealment. A favorite "make up" is streaks of green and coffee color. Thus disguised the sniper conceals himself at night in a cluster of vegetation from which the hostile trenches can be observed. At daybreak he opens fire upon any target presented. It is almost impossible to locate him even when in motion, as the disturbance he causes in the vegetation resembles the waving of leaves in the wind.

The sniping methods of the English soldiers rival those of the North American Indians, and their artificial protective coloration is very similar to the war paint of these savages. Investigation has determined that the Indians had a practical object in painting themselves so fantastically. This was, as at present with the English soldiers, to facilitate concealment. The Indians of the western plains colored their bodies to harmonize with the fiery hued rocks and sun parched deserts, while the Indians of the east used softer colors, green and chestnut, to blend with the more abundant foliage of this region.

Some ex-actors in the English army have gained great reputation for their artistic ability in making up the men.

—Strategic

[Strategic Camouflage. By "Eo Chaille." *Army & Navy Gazette,* Aug 10, '18. 2200 words.]

Camouflage as a science is still in its infancy. The production of scientific camouflage is rendered necessary by the ability of the airplane photographer to accurately record troop movements, use of roads, new paths, etc., thus rendering ordinary natural "cover" useless as a screen.

The "Hun" has hidden his movements successfully on more than one occasion and there are, broadly speaking, two methods by which this can be done. The enemy can move at night to prepared rendezvous in which he can conceal his troops during the day, or he can provide covered ways to suitable natural hiding places.

It is, however, likely that he uses a combination of both methods, preparing screened approaches and exits, so being able to march at night and debouch as he pleases. His place of assembly would then be safe. Knowing his point of attack far in advance he would be able to prepare the ground effectively so that a surprise could be effected. This is called strategic camouflage and is as far out of the ordinary as a decisive battle is above a skirmish. To counterbalance conditions where each side, by airplane reconnaissance, is fully cognizant of each other's move, we must use camouflage to conceal concentrations and place genius once again above brute force. No one can help, however complete the mastery of the air may be, a stray airplane from photographing your lines. The camouflage for each branch of the army is different. What will suit the infantry will not suit the artillery, etc. It would appear necessary to train camouflage specialists for each. When this method is perfected it should be easy to issue plans of a strategic nature.

CANADA

—Army

See also

EUROPEAN WAR—FORCES ENGAGED—CANADA

—Expeditionary Force for European War

[What Canada Has Done. *Canadian Military Gazette,* Aug 13, '18. 1200 words.]

A statistical summary of Canada's accomplishments in the present war, in men, arms, money, food, etc. Among the most interesting are:

The regular army has been increased from 3000 to 450,000. Out of the 390,000 sent to France, there have been 113,007 casaulties. Sixty million pounds of shell and 100 million pounds of explosives with 2500 airplanes have been produced. 112 vessels have been built totalling 450,000 tons. The average annual exportation of wheat has increased 80 million bushels and beef 75 million pounds. Canadian expenses up to March 31 of this year totalled $875,000,000.

—Sanitary Service

[Canadian Military Convalescent Hospitals. *Modern Hospital,* Apr, '18. 3000 words. Illustrations.]

(This article gives a brief review of a number (month not stated) of *Construction,* a Canadian architectural journal published in Toronto. The number reviewed was devoted to Canadian military hospitals. The leading articles discussed "Canada's Military Convalescent Hospitals," "The Kitchen and Dining-room Problems," "Converting Immigration Sheds into Hospitals," "Care of Soldiers Suffering from Tuberculosis," and "System of Hospital Construction." A condensation of each of these articles is given in the review.)

CANUTE THE GREAT

[From Pirate to Empire Builder. By M. Adeline Boulter-Cooke. *United Service Mag.*, June, '18. 1800 words.]

(Historical, being a brief account of the life of Canute the Great, who, from the position of a younger son, rose to be the ruler of Denmark, England, and Norway. Some of the ways by which he advaced were devious. He was "a strong man, one who knew his own mind and deserved to win.")

CARBINE

See

CAVALRY—ARMS—CARBINE

CARD INDEXES

[The Card Index in Military Offices. By Captain G. L. Groves, 1-4th Bn. The Queen's Regiment. *The Journal of the United Service Institution of India,* July, '18. 2300 words. 2 cuts.]

The article was written from the standpoint of a company commander of British Infantry Regiment and deals with the filing of general informaton and records of any military unit, be it infantry or artillery or cavalry.

The card index is a popular system and is used extensively in modern business. It is extremely simple, has a nominal cost and an unlimited adaptability. It makes books unnecessary in keeping records and the like.

The article then shows, by taking as an example a single man, how much of that man's record can be kept on a small card (four by six inches), and the uses of the card index after completion not only by officers but also by the non-commissioned officers of the company.

CARS

—Armored

See

AUTOMOBILES—ARMORED

CAVALRY

See also

AERONAUTICS—RECONNAISSANCE
HORSES
MACHINE GUNS—TROOPS—CAVALRY

Mexico

[The Mexican Cavalry and Its Future. By Gen. Eduardo Paz. *Revista del Ejército y Marina.* Mar-Apr, '18. 2000 words. (Continued.)]

(The first installment of an article on cavalry. The author does not discuss the Mexican cavalry in this installment. The history and development of cavalry drill regulations in France and in Germany are discussed, also the general requirements of a good cavalry regulations.)

—Arms—Carbine

[The Carbine Carried on the Back. Valdes. *Boletín del Ejército,* Cuba, Aug, '18. 2000 words.]

In the spring of 1918, two troops of the author's regiment took advantage of a march of some duration to test the method of slinging the rifle on the back of the rider. Daily, the men reported with badly bruised backs. They continually shifted the length of the sling in an attempt to better matters, but this gave no relief. The entire march was made at a walk, except for a ten minutes' trot by one troop, and men at the rear of the column.

Using the rifle mounted, tests with blank ammunition showed that a man carrying his rifle in the boot, when placed against one with the slung rifle, could get in two shots always, and sometimes three, before his adversary could so much as unsling his piece.

The author makes mention of articles on both sides of the question that appeared in the *Cavalry Journal,* and quotes these to some extent.

Another drawback remarked was the way in which the muzzle invariably caught on any vegetation that presented itself.

When the gun is carried in a boot, any sores due to it must be on the withers, as the Cuban gun is fastened there. Of twenty-one horses examined, all of whom had carried the gun in this manner, none had sore withers, five had lesions on the right side of the back, three on the left, ten on both sides, and three none at all.

—Arms—Saber

See also

FENCING

—Fire

See also

SEARCHLIGHTS

—Instruction and Training

[Practical Instruction. By F. Altoaguirre. *Memorial de Caballería,* Oct, '17. 2800 words.]

Practical instruction may be divided into two great groups; first, exercises without troops, and secondly, exercises with troops.

The first group may be subdivided, since it is possible to effect this character of instruction both on the map and actually on the ground. Instruction could hardly be called practical, however, unless it be actually carried out on the ground.

Exercises with troops can never be accomplished in the conference hall altho at first sight it would appear that a part of them might be developed on the map. The latter work includes in reality the preparatory measures only, and sometimes the critique, but never the exercise itself.

The cavalry officer can practice in the field, even without troops, whatever may constitute the exercise of his professional mission. Knowledge of topographical features, the effects of light, correct estimation of distances and of slopes and profiles, etc., can be acquired only by actual practice.

Exercises without troops that can be realized in the study hall have two distinct tho complementary ends. (a) To acquire great facility in the use of maps and sketches and (b) to obligate a study of the art of war and of all matters related to it.

To avoid monotony friendly competitions in describing in military terms a given piece of ground, and in sketching it should be arranged between junior officers.

CAVALRY—Continued

Exercises with troops are a necessary complement to practical instruction. Actual war conditions should be simulated.

What has been written in this article may be summarized in the following conclusions:

1. Exercises of a practical character are more necessary to cavalry officers than to those of any other arm.

2. With large, average and even small bodies of troops it is possible to give great intensity and extension to practical instruction.

Spain

[Manœuvres of Cavalry Academy. "X." *Memorial de Caballería,* June, '18. 2400 words.]

The entire Academy was formed into one troop of three line sections, one machine gun section and one demolition and liaison section, in all, 185 men. The first day's march, Valladolid-Rio Seco, was forty kilometers, covered in five hours (5 miles per hour). Next day they made 75 kilometers to Mansilla, losing one horse by congestion of the lungs. After stables the men were turned loose and allowed to go to the nearby towns. The third day's march to Leon was 18 kilometers. The infantry regiment stationed in Burgos occupied the bridges over the Torio, and were acted against by the troop, acting as the advance guard of a column. The infantry fell back on Leon without offering battle. At Leon the horses were given stables, altho the organization was supposedly in the field.

At Leon the cadets attended daily instruction, leaving town at five every morning for the foothills, nine kilometers off. These exercises included patrols, outguards, advance and rear guards, firing problems, etc. The first classmen were sentinels, mounted messengers, etc., the second class took care of demolition, liaison and other technical duties, and the third class took command. (Unlike the United States, the Spaniards call their oldest class of cadets third classmen.) Telephone communications were complete in every detail, and the demolition of a wooden bridge was effected. Machine gun firing problems were especially gratifying. Critiques followed all operations.

On the 18 kilometer march to Mansilla, a second horse was lost from exhaustion. The troop left Mansilla at midnight for a forced march of 116 kilometers (72 miles) into Valladolid. They covered 38 kilometers by dawn, and allowed one hour for breakfast, and stables. At noon a four-hour halt was allowed. The Academy was reached at nine in the evening, total time being twenty-one hours. The cadets evidenced a most commendable spirit in the way in which they adapted themselves to all the problems.

—Organization

[Cavalry Matters. About Organization. By Two Captains. *Memorial de Caballería,* Oct, '17. 4600 words. 1 sketch.]

(Continuation of a scheme for the organization of the Spanish cavalry.)

There are eight squadrons. The sixth squadron includes two machine gun sections, one communication section and one demolition section.

The seventh squadron consists of the regimental trains.

The eighth squadron is the reserve or depot squadron.

Three or four horses for each squadron carry food and kitchen equipment. At least two horses should carry ammunition, and two others picket lines, lanterns and other articles of camp equipment.

The armament recommended for the cavalry is as follows:

Cavalry Division—Lance, carbine, pistol and saber.
Divisional Cavalry—Carbine, pistol and saber.
Machine Gun Section—Machete and pistol.
Communication Section—Carbine, machete and pistol.
Demolition Section—Carbine, machete and pistol.
Seventh Squadron—Carbine and machete.

(A map problem for a division of cavalry is included. An army corps is marching southwest from Madrid with the cavalry division in advance, the mission of the latter being both security and reconnaissance.)

[Notes on Organization. "Two Captains of a Division." *Memorial de Caballería,* May, '18. 2000 words.]

The abolition of regiments of divisional cavalry, and the assumption of that duty by the depot troops of the regiments (Escuadrones Quintas), has given Spanish cavalry its chance for higher training. To be effective, cavalry must act in large units. Due to its mobility, a large body of cavalry cannot be demoralized by a retreat. At regimental posts divisional training has been impossible. To act in war with large mounted bodies, cyclists and armored cars must do so in peace. Machine guns must be taught large scale team work. In short, results of isolated training are entirely at variance with those of combined work.

The author weighs against one another the use of three divisions of three brigades of three regiments, or of seven divisions of two brigades of two regiments, favoring the latter as he considers four such divisions sufficient to cover Spain in event of mobilization, leaving the remaining three under the command of an able leader as a strong offensive weapon. (Six hundred men is the strength of the Spanish cavalry regiment.) He contemplates with each division a cyclist battalion, two machine gun groups, six pieces per group, and a unit each of artillery, sanitary, engineer and aviation troops.

Germany

[More Teuton Cavalry. *Jour. U. S. Cav. Assn.* Jan, '18. 800 words.]

Trench warfare has not diminished the German cavalry forces, the total number of squadrons in the service being even higher than it was at the mobilization in 1914. Changes, however, have been introduced by which some of the squadrons have been dismounted temporarily and utilized as infantry, while the formations have undergone considerable variation.

At present the German Army has no fewer than 649

squadrons of cavalry, comprising active, reserve, mobile *ersatz, landwehr* and *landsturm* units, but of these 144 have been dismounted and used as infantry. This figure compares with 440 squadrons on a peace footing.

When war began the German cavalry was at once formed into eleven divisions, each composed of six regiments of four squadrons. Besides those, there were also bodies of divisional cavalry attached to the active and reserve divisions of infantry. Rumania's entry into the war made more cavalry formations necessary and the number of organized divisions was at once increased to fourteen.

The spring of 1917 saw the end of the Rumanian campaign, and with this came a decrease of the divisional formations to six while the divisions themselves were reduced from six regiments to four each. At the same time independent brigades of mounted troops were formed, of which the existence of at least five is known, each having three regiments of four squadrons.

Nearly every infantry division is provided with a unit of cavalry whose strength varies according to the nature of the country in which the troops are operating.

From among the cavalry men who, temporarily, are not employed on mounted duty at the front, twenty-three regiments of riflemen have been formed, which take their turn in holding trenches with the ordinary infantry formation. Each of these regiments is composed of four squadrons and a squadron of machine gunners.

Besides these, other units of cavalrymen selected from the regiments of the active army are from time to time used as infantry, but their exact numbers are not ascertainable.

Switzerland

[Our Cavalry of To-morrow. By Lt.-Col. de Diesbach. *Revue Militaire Suisse,* May '18. 2700 words.]

Cavalry may still be counted on to play its historic part in battle, but there have been great changes in tactics. Cavalry can no longer be used as a screen, for from the airplane nothing is hidden. The Germans all along have avoided the useless mounted attack, but the French, inspired by all the ancient traditions, have ridden recklessly to the attack. The raid of General Sordet toward Liège with cavalry was a vain and useless procedure. His mode of action permitted only attack and that mounted. But the orders of General Joffre to his cavalry, given in September, 1914, put an end to these ancient ideas. Since then the French cavalry has been merely foot-soldiery. In Germany it is the same except that in Galicia, in Poland, Russia, and Rumania cavalry has had many occasions to act as such because of the immense distances, poor routes of communication, or an enemy beaten and in retreat. In Italy it is certain that a corps of cavalry of the Central Powers turned a mere defeat to a crushing blow, the Alps only saving the Italians from complete humiliation. On the other hand it cannot be denied that the daring work of the Italian cavalry prevented their adversaries from reaping the full benefits of their victories.

So the value of a good cavalry after the battle and in the pursuit, also to cover at some distance an exposed flank or to fill a temporarv gap, is readily seen. But it must be endowed with all the new technical resources. Nevertheless, cavalry is expensive, vulnerable and delicate. A cavalryman, fighting on foot only occasionally, will never be the equal of a purely foot soldier. His only advantage is that he can get to a place where the infantryman might get too late or not at all. Even here the development of automobiles reduces his advantage to a minimum. So it may be said that cavalry is not always absolutely indispensable in modern warfare, but there may be times when it would be valuable and other times when it would be absolutely essential. The French had at the first of the war, apparently too much cavalry and not enough machine guns and heavy artillery. The Germans do not seem to have had too much if one considers the enormous losses in horses and the great work done on the eastern front. The rule then should be: as necessary as cavalry is at certain moments, it is not always so, and the men and horses who compose it could be used in a different manner. That is to say, an army which can afford a numerous cavalry would be wrong to deprive itself of it, but those armies which must be reduced to the indispensable should decrease it.

In the Swiss Army the duties of the divisional cavalry are clear, they are needed. But of what utility is the cavalry of combat, the dragoons? Because of the small area of the country, the hilly terrain, the great cost, automobiles would be better. For a long time the development of machine guns, the generalization of rapid-fire artillery, the flattening of the trajectory of rifle fire, the growth of the automobile industry and the progress of aviation have been killing all hope of the happy intervention of cavalry, with its toy guns, its few machine-guns, its archaic methods of fighting on foot. The Swiss dragoons could be better used in a division of a new type composed of a brigade of cavalry of two regiments, each composed of six squadrons of dragoons and three machine-gun squadrons. This division would make two groups now nearly useless into a reserve of great value. Horses left over could be used to draw or mount two new batteries of 15 cm. guns.

United States

[Note. *Army & Navy Jour.,* Dec 15, '17. 150 words.]

Orders have been dispatched from the War Department providing for the organization of a full division of Cavalry at El Paso, Tex. According to official information this step has no connection with the confused situation below our Southern border. That the formation of the division is in preparation for a possible "break" on one of the European fronts is the interpretation generally made of the Department's action. The division is to be formed by the expansion of existing regiments now on border duty. Several of these units already have been ordered to El Paso, where they will be split, the resulting halves being brought to full strength by assignment of recruits.

—Reconnaissance and Scouting

See also

AERONAUTICS—RECONNAISSANCE BY

CAVALRY—Continued

—Tactics

[The Trend of Cavalry Action. By Lieut.-Col. C. D. Rhodes. *National Service*, Dec, '17. 3000 words.]

For the past half century there has been no arm which has been so much discussed as to its tactical rôle as the cavalry. The infantry, always true to type in being the real frame work for all offensive or defensive action, has found the details of its work changed, but the fundamentals of its employment have never been in question. The artillery has gone thru a wonderful development, but there has been little or no doubt as to the rôle it must perform. The function of the cavalry under modern conditions has been widely discussed, on the other hand.

The operations of the German cavalry in the Franco-Prussian War tended to create in the minds of cavalry leaders the idea that mounted action was to be the principal rôle of their arm. The lessons of the American Civil War were entirely disregarded. There grew up a great divergence in the organization, equipment and training of the European as compared to the American cavalry. A European cavalry regiment consists of four to six units commanded by captains. The American regiment has twelve of these units, and is thus much larger and much better suited for dismounted action. The arms of the American trooper are also greatly superior for dismounted work. European cavalry has been trained to rely almost exclusively on shock tactics. The American cavalryman has been trained in this, but greater reliance has been placed upon open order for mounted combat. He is also carefully drilled in dismounting to fight on foot, probably getting more of this instruction than of any other kind of offensive tactics.

The lessons of the present war seem to indicate that the American system of cavalry training and the conception of the true rôle of modern cavalry was the correct one. While there were a number of cavalry actions in the first part of the war, it appears that in most cases the work could have been better done by troops trained along the American lines. With the settling down of the armies into the entrenched lines the use of cavalry in its true function came to an end, as far as the western front was concerned. In the east there has been a great deal of mounted work. All the belligerents have maintained their cavalry, however, and have apparently been arming and training it in a much closer approximation to the American system than has been the case in the past.

Considering the war as a whole and what has occurred on all fronts, it appears that modern cavalry must be prepared to do all that is expected of good infantry, and in addition must still possess that mobility of action mounted which is all that renders cavalry *per se* valuable in offensive or defensive warfare. It must be highly specialized in all that pertains to its many sided functions; like the infantry, it must be properly supported by a strong and efficient artillery and aviation service; and above all it must possess commanders able to divine the psychological moment when its use may be able to turn the tide of battle.

—Use of in European War

[British Cavalry in Action. By P. Gibbs, Sp. Cor. N. Y. *Times*. *Jour. U. S. Cavalry Assn.*, Apr, '18. 700 words.]

The writer was an eye-witness of splendid work of the British cavalry in recent fighting about Ham and Guiscard, and their patrol work below Delville Wood and Pozières. After Mar 22 the action was varied, both mounted and dismounted, rearguard, patrolling, etc. On Mar 22, they held, dismounted, the Ollezy-Ham line against heavy odds, some troopers fighting all night to cover the withdrawal of their comrades. On the 26th the cavalry held the southern slope of Porquericot Ridgé with their left flank in the air, remaining flanked and under heavy fire until the conclusion of the Allied withdrawal to the Driette River.

After supporting the British infantry near Marcelcave, dismounted cavalry, with one mounted squadron, made a gallant attack thru Moreuil Wood and cleared out the enemy. Later the Germans reoccupied the wood with machine guns and the British cavalry were ordered to clear it. This was on the morning of Apr 1.

Twelve hundred troopers who had marched all night charged the wood in three waves. The first wave rode to the edge of the wood, and the second to the center, and the third wave went home to the other side. They cleared Moreuil Wood of the Germans, bringing back prisoners and thirteen machine guns, tho their losses were heavy.

[Cavalry in the Present War. By Major Ramon Cuedra. *La Guerra y su Preparacion*, Mar, '18. 2000 words.]

(This article was published to the Italian Army as a royal order from Army Headquarters.)

An Austrian official order of Aug 31 states among other things the following: "Along with the many methods of attack by which the enemy attempted to break our resistance, he yesterday employed a new one, absolutely unlooked for. On the East of Britof, the Italian cavalry went into action against our trenches and it was received by our machine guns, whose fire destroyed the advancing cavalry.

This cavalry was actually employed on the day of Aug 30. The Austrian machine guns did not destroy it entirely. Some of the squadrons of the 12th Light Regiment, and of the 24th Regiment sent forward reconnoitering patrols into the country to the east of Britof.

It is true that trench warfare very rarely offers occasion for the strategic and tactical employment of cavalry, but every opportunity to employ the Italian Cavalry has been used. In the above instance, the cavalry was used simply for fighting on foot and acquitted itself very creditably.

At the beginning of the war two cavalry divisions charged with the duty of covering the concentration on the Tagliamento River took part in the advance on the 24th of May, 1915. The Second Division engaged in a combat at Aris on the 5th of July.

After this, the war became more stabilized along the trench lines, and as this new method of warfare was adopted, the cavalry divisions sent forward their machine gun regiments into the trench lines to the First and Third Armies, where these detachments did good work. In bloody attacks in July and October on the crest of Mt. Carso, several machine gun sections which had been transferred from the cavalry were completely annihilated.

CAVALRY FIGHTING ON FOOT

During the winter of 1916 the cavalry belonging to the First, Second, and Fourth Divisions made a study of dismounted action, and in March of the same year the cavalry regiments of these three divisions, reorganized with various squadrons from supplementary troops attached to the army corps, were prepared to go into action. Twenty-nine regiments were represented in the dismounted units. In the early part of March, 1916, the First Division garrisoned the sector Canele-Plava, and the Fourth from Monfalcone to the sea. Later a division reinforced by some infantry units put up a very ferocious fight from the 10th of May thru the 15th and 17th, when, due to the violence of the enemy's fire, it was forced to withdraw. When the Austrian salient between Brenta and the Adige River appeared most menacing, the Second Division was once more mounted and sent to the Vicenza Plains, where it fought with the infantry on the Beole Pass and into the Valley of Assa. In this combat the Austrian offensive was broken on the Asiago plateur, and the squadrons of the 16th, 18th, 21st, 27th and 30th Regiments of cavalry were sent forward to make an attack on the retreating enemy. The squadrons were broken up into patrols which kept up a steady dismounted action and accomplished their mission in an exemplary manner. On the 8th of August, before the Italians had taken Savotino and St. Miguel, the Austrians withdrew. The 14 squadrons from the 2nd, 15th, 16, 18th, 22nd and 29th Regiments of cavalry crossed the Isonzo River near Goriaza and went into action against the enemy's rear guard. The squadrons from the 29th Regiment charged the enemy near Merna, where they rolled back one flank, which had been reinforced with machine guns.

RECORD OF THE GENOA REGIMENT OF CAVALRY ON HILL 144

In the middle of July the first dismounted division, to which was attached the Fourth or Genoese Regiment, and the Fifth, Thirteenth and Twentieth Regiments, were in position before Hill 144. The Fourth Division returned to Carso on the 10th of August, and two squadrons of the Fifth Regiment went forward to attack Cosich. The enemy was driven out so rapidly that the two squadrons were able to reach the Debeli. On Sept 14 the assault against Hill 144 was undertaken. At that time this was one of the most formidable points of support of the Austrians. As it guarded the southern exit to Vallone, it prevented the Italians from going forward between the southern edge of the Carso plateau and the sea. The Fourth Cavalry Regiment formed one of the columns of attack assisted by the 22nd and 132nd Regiments of infantry. The Fourth Regiment descended from the Debeli under an intense machine gun and rifle fire and climbed the opposite side of Hill 144, forcing the enemy from his trenches and fortifying themselves on the crest. Later on they were reinforced by the First and Second Squadrons, and near the end of the day by the Third Squadron, which had remained in the jumping-off trench. During this time several Austrian counter attacks were launched and these were repulsed under great disadvantage, as a torrent of rain had come up and the cavalrymen found themselves short of ammunition. equipped only with short bayonets, and cut off from their reinforcements by the Austrian barrage. During the day of the 15th of September, further Austrian counter attacks were launched and repulsed, tho the Austrians maintained a consistent heavy artillery fire over all points occupied by the Italian cavalry and the supporting infantry.

On the morning of the 16th, orders were issued to go down the opposite side of the Hill 144 and capture all Austrian positions on the east side of the hill. The Bersaglieri cyclists of the Fifth Battalion reinforced the Genoa Cavalry in this action. At 8 a.m., the Third and Fifth Genoese squadrons and the Sixth Royal Squadron from Piamente went over the top with the cyclists. The Austrian position. was captured in a few minutes and remained in Italian hands in spite of the furious counter attacks of the enemy. During the night of the 17th the Genoese regiment was relieved and sent to the rear to rest.

At about this tme the regiment of light cavalry from Rome captured Hill 77 east of Montfalcone. From May to December, 1916, the 15th, 22nd and 30th Light Cavalry Regiments, which had been attached to the Albanian expeditionary troops, took part in the actions at Voiussa and against the Hill of Malakastra.

ARTILLERYMEN, BOMBERS AND MACHINE GUNNERS

At the end of 1916, the dismounted cavalry divisions were withdrawn from the front and reorganized as cavalry proper. A large proportion of the cavalry personnel of these divisions remained near the front doing special duty work of all sorts. About 13,000 men were detached from the cavalry as bombers. Thirty machine gun companies were organized from the cavalry regiments. Several hundred cavalry officers were transferred to the artillery and aviation, and many officers were detached as liason officers.

The Italian cavalry at the beginning of the war was considered to be the most admirably organized and equipped cavalry of Europe. The cavalry could not be used in trench warfare, consequently in the organization of the various cavalry divisions their strength was cut down and the extra men were transferred as has been indicated, to the other services made necessary by the new conditions of warfare.

CENSORSHIP (Of the Press)

See

PRESS CENSORSHIP

CHARLEROI, Battle of

[The Battle of Charleroi. By Maj. T. E. Compton. *Jour. Royal United Serv. Inst.*, Feb, '18. 7500 words. 2 sketches.]

CHARLEROI, Battle of—Continued

The French plan was a general offensive, and the angular front from Longwy to Lille was not intended to be a defensive one. While the Third and Fourth French Armies, from Longwy to Mezières, attacked the enemy's columns moving thru Belgian Luxembourg, the Fifth Army and the British Expeditionary Force, pivoting on Namur, were to have wheeled half right from the Sambre and attacked whatever German forces were found on the left bank of the Meuse.

The advance of the First and Second German Armies to Valenciennes, Mons, and the Sambre was carried out in execution of a plan of campaign which was nothing more in principle than the horn tactics by which the Zulus conquered all the native races of South-East Africa. Of the seven armies engaged in it, two on each flank were the horns; the remaining three armies filled the interval between them. The armies of the Crown Prince of Bavaria (Sixth) and von Heeringen (Seventh) forming the left horn made a determined attempt to force their way thru the Trouée de Charmes and failed. The two armies forming the other horn, those of von Kluck (First) and von Bülow (Second), overcoming the opposition offered by the Allies at Namur and on the Sambre, prolonged the encircling movement of the right horn as far as Meaux, the intention being to push the point to the Seine, and even south of that river.

Blocked on his left by the French fortifications and the armies of Generals de Castelnau and Dubail, and defeated and forced back to the Aisne on his right, he proceeded to extend his line of entrenchments to the sea on one side and to a neutral frontier on the other.

The French plan was to hold, with the armies of General de Castelnau and Dubail, the left wing, or horn, of the enemy's advance, and then, with every available unit, to attack his center and right while on the march on both banks of the Meuse. On the right bank, the Third and Fourth Armies, eleven corps strong, facing north between Mezières and Longwy, were to attack the German center in the Belgian Ardennes, while, on the left bank, the Fifth Army, under General Lanrezac, pivoting on Namur, attacked the enemy's right wing.

On the 19th the French cavalry corps was heavily engaged at Perwez, and retired on the 20th to the Charleroi-Brussels Canal, Gosselies and Fontaine-l'Evèque. On this same date the various corps and divisions of the Fifth Army had reached positions as follows:

The Ist Corps was opposite Dinant, guarding the bridges over the Meuse.

The Xth Corps was on the Sambre on the right bank, opposite Anvelais and Tamines.

The IIIrd Corps continued the line to the left and was opposite Châtelet and Charleroi.

The XVIIIth Corps had just detrained nearly 20 miles from Charleroi.

The 4th Group of Reserve Divisions was still further behind.

Thus the French position on Aug 21, at the beginning of the Battle of Charleroi, faced north from Anvelais to Marchienne, on the Sambre, with the left refused by the XVIIIth Corps, which had come up.

The First Day, Aug 21, 1014

At about 12:45 p. m. the first infantry attack was delivered on Anvelais by advanced troops of the Prussian Guard Corps, which was repulsed. Tamines and Anvelais were soon exposed to the plunging fire of the enemy's artillery posted on the heights of the left bank. The 38th Brigade retired to positions about 600 yards in rear.

At 2:30 p. m. an attack in force carried Anvelais. The 20th Division was brought up in support and the 19th Division was ordered to retake Anvelais. The attack was made after a very ineffective artillery preparation and failed.

Between Anvelais and Namur the Germans made no attempt to cross the Sambre except after the defeat of this attack, when they attacked Ham from the right bank. By nightfall Tamines and Ham were lost by the French, and the 19th Division fell back to the line Fosse-Vitreval-Saint Eustache, when the whole Xth Corps took position in readiness for the continuation of the battle on the 22nd.

The IIIrd Corps, which had its posts on the bridges over the Sambre, was attacked by the German Xth Active and Xth Reserve Corps. The 5th Division was forced back about two miles to a front between Loveral and Presles. The 11th Brigade of the 6th Division was engaged at Anderlues, while the remainder of the Division was still in the neighborhood of Villers-Poterie. The IIIrd Corps, with three brigades still unengaged, altho it had lost the bridges and evacuated the faubourgs of Charleroi, had not retired nearly so far from the river as had the Xth Corps. Its front line ran from Loveral to Presles, while its second line at about Villers-Poterie connected with the Xth Corps first line, Vitrival-Fosse.

The XVIIIth Corps occupied the bridges at Thuin and Merbes le Château, and organized a defensive position on the heights of the right bank between Gozée and Ham-sur-Heuse where it remained thruout the night and following day.

Namur and the Meuse were named as the pivot for all the Allied operations on and beyond the Sambre. To make the Meuse from Namur southwards a sure and efficient barrier, the 51st and 52nd Divisions had been detailed to guard the bridges at Dinant and Givet. The 51st had not yet arrived and the 1st Corps was, therefore, out of action. But as long as Namur stood firm, there were always possibilities of the Ist Corps eventually operating with effect against the left flank of the German forces that were attacking the French Xth and IIIrd Corps on and south of the Sambre.

But Namur was attacked by von Bülow's Army, while von Kluck was still marching some miles to the north of the Sambre, in a southwesterly direction, thru Louvain and Brussels, on Tournai, Condé, and Mons. The Guard, Xth, Xth Reserve and VIIth Corps of von Bülow's Army were attacking the French on the Sambre, while the VIIth Reserve Corps attacked Namur.

At nightfall, the length of time that the fortress could hold out was doubtful. Two forts had been knocked out, and the others had suffered. It was hoped, at least by the commander of the Fifth Army, that it could hold out for some days yet.

The Second Day, Aug 22

Namur consisted of a citadel surrounded by nine cupola mounted detached forts, of which four were north and east of the town, three in the angle formed by the Meuse, and two to the west in the angle formed by the Meuse and the Sambre. The German VIIth Reserve Corps made no attempt to surround the place, the enemy's system being to attack one or two forts at a time, and having silenced them, to push his assaulting parties between them.

Marchovelette, Coguelée, and Maizert were silenced by bombarding them with 8-inch and 12-inch howitzers and the famous 420-mm. mortar. By evening Namur had ceased to be a safe point on which to pivot the maneuver.

The 1st Corps of the Fifth Army still waited opposite Dinant, its relief by the 51st Reserve Division, and took no part in the fighting.

The Xth and IIIrd Corps were ordered to combine with the object of regaining the initiative, which at the close of the battle on the first day had passed entirely to the side of the enemy. In order to get in touch with the first line of the IIIrd Corps, the 19th and 20th Divisions began at 3:30 a. m. to advance in the direction of Anvelais and Tamines. All the artillery of the Xth Corps was in position on high ground north of Fosse and Vitrival to support this advance.

The IIIrd Corps, after the desperate night attacks, had its first line much nearer to the bridges of Châtelet and Charleroi than that of the Xth Corps from Tamines to Anvelais. The 5th Division, therefore, remained where it was until the Xth Corps had come into action. About 8 a. m. the orders were issued for an attack on Châtelet. The 20th Division of the Xth Corps attacked and took Falisolle, while the 19th Division occupied Arsimont until about 11 a. m., when it was forced to evacuate. The 37th Division made the counter attack, but without result.

The 38th Division d'Afrique made a determined attack on Châtelet but was forced to withdraw with very heavy losses. The IIIrd Corps was then ordered to retreat on Nalinnes and Somzée.

The Xth Corps, with its left flank uncovered by the retreat of the IIIrd Corps, and closely pressed by the German Xth and Guard Corps, fell back to the line: Fosse-Vitrival-Saint-Eustache. Retreat was resumed towards evening to a line in the neighborhood of Mettet, in touch with the IIIrd Corps. The XVIIIth Corps carried on the line at Gozée, and was still holding the Sambre bridges at Thuin and Merbes; its artillery only had joined in the day's action. The 11th Brigade retired in the evening and joined the XVIIIth Corps.

The 4th Group of Reserve Divisions moved up from Avesnes at nightfall and took up a position on the left of the XVIIIth Corps from Montiguies to Maubeuge, facing north.

Two corps plus two African divisions had been beaten and had suffered heavy losses, but they had been able to fall back between two other corps that had not been engaged at all. On the right was the 51st Reserve Division, and on the left, the 4th Group of Reserve Divisions—all fresh troops.

The fall of Namur at once released the enemy's VIIth Reserve Corps, and allowed his Third Army to attack the passages of the Meuse south of the fortress without fear of interference on the flank. The German XIIth Corps had been freed by these operations and the French 1st Corps was now required to make head against it, in reinforcing the 51st Reserve Division and preventing any further advance of the enemy against the communications of the Fifth Army.

On the evening of the 23rd, the Fifth Army extended between Dinant and Maubeuge, the XVIIIth Corps having fallen back from Gozée after a combat with the German VIIth and Xth Corps. When the British Army reached the Condé-Mons-Binche front, it was exposed to attack by the whole of the German First Army. It fought on the afternoon of the 23rd and on the morning of the 24th, but it was then necessary to retire to the Maubeuge position.

While the Fifth Army retired on the line Marvilles-Avemes-Fournies-Regmourez, the British force began its retreat to the Seine.

At the Battle of Charleroi, the Germans attacked unexpectedly, when the orders for an offensive movement on the part of the French were in course of being drafted. The French plan thereupon resolved itself into a general attempt on the part of the IIIrd and Xth Corps to regain the bridges over the river between Ham and Charleroi and, with them, the initiative. The non-employment of part of the Ist Corps, and the absence of initiative on the part of the XVIIIth Corps, which remained out of action, except for its artillery, altho the Army Commander counted on its crossing the Sambre and advancing to the Charleroi-Mons road, were due to this sudden loss of the initiative and the want of a carefully prepared defensive plan, until it was too late to put it into execution.

The Germans attacked boldly, accepting risks, in full confidence that superior armament and readiness would prevail against an unconcentrated enemy. In minor tactics they showed superior training in entrenching and preparing for defense positions captured.

The French artillery preparation was insufficient and ineffective, and lack of co-operation with the infantry was marked. In advancing, captured positions were not reorganized promptly, nor was the artillery brought up promptly.

On the side of the French, the battle furnishes an example of lack of combination and mutual support as complete almost as the battle of the Marne is an example of the exact contrary. But whatever temporary success might have been gained by the French under more fortunate direction, or if Namur had not fallen, the defeat of their Fourth and Fifth Armies

CHARLEROI, Battle of—Continued

in the Ardennes and the consequent pressure of the German Third Army on the right flank and rear of the French Fifth Army, must, in any case, have necessitated eventual retreat from the Sambre and into French territory, in order to maintain connection with the remainder of the French forces. Even if all the units of the Fifth Army and the British Army had been in position on the 20th, ready to carry out the movement indicated by the Generalissimo, the execution of this plan, however successful, was fatally tied to the fortunes of the French in the Ardennes. Only success there could make the communications of the Fifth Army safe against attack from the direction of Dinant or Givet.

The Generalissimo's plan was a good one. It was a bold attempt to carry the war beyond French territory from the outset. It failed because the enemy proved to be in greater strength and readiness for battle than was anticipated.

CHILE

—History

[The Chilean Army in the Years '38 and '39. By Capt. Gonzalez. *Memorial del Ejército de Chile,* Oct, '17. 3000 words.]

The regular army was formed at this time of 3000 men distributed in three arms: infantry, cavalry, and artillery.

The artillery consisted of one regiment (headquarters and six companies).

The cavalry was composed of two regiments, one separate squadron, and one separate company; each regiment had a headquarters and three squadrons, the squadron consisting of two companies and each company having four officers and 80 enlisted.

The infantry consisted of three battalions of six companies each. Of the six companies, one was a grenadier company, one a chasseur company, and the remaining four, rifle companies. Each company had three officers and 65 enlisted.

The majority of the officers were graduates of the Military Academy. This institution was founded in 1817. The theoretical instruction included courses in arithmetic, algebra, geometry, trigonometry, map making, military orders, permanent and field fortification and tactics of infantry and cavalry. French regulations were used in infantry and cavalry instruction. No regulations were available for the artillery so the principles in use prior to the War of Independence were followed. Enlistment was voluntary.

National Guard units were first organized in 1825. In 1835 this service consisted of three brigades and one company of artillery; two regiments, 15 separate squadrons and one company of cavalry; 14 battalions and three separate companies of infantry.

Unlike the Regular Army the National Guard had no permanent system of instruction. Units were assembled on Sundays and feast days to practice close order movements and volley firing.

The armament of the artillery consisted of cannons, mortars and serpentines.

The cavalry used the carbine, lance and pistol.

The infantry had the musket and bayonet. The musket, cal. 16 mm., had an effective range of 200 m. with an extreme range of about 400 m.

The glories of the campaign against the Confederation (Peru and Bolivia. Ed.), followed by the successes of the long and severe campaign of Arauco, constitute the traditions of the Chilean Army of '39. This army, which 40 years later overcame the forces of the same two nations, had been allowed to remain in an unprepared condition since the year '39.

Victory after 40 years of absolute stagnation can be attributed only to the traditions and lessons inherited from the first Chilean Army in the campaign of '38-39.

[Activity of the Historical Section in the Military Year 1916-1917. By Lt.-Col. Diaz. *Memorial del Ejército de Chile,* Oct, '17. 3100 words]

The work of this Section during the past year has been as follows:

(1) The editing of a narrative account of the Civil War of 1891.

(2) The printing of an index to the compilation documents relative to the War of the Pacific by Don Pascual Ahumada Moreno.

(3) A compendium of the military history of Chile. This work has only been started.

(4) Reprint of the work of Col. Bertling on the passage of the Andes, made in 1817 by the Army of General San Martin.

(5) Some works of Collaboration for the *Memorial* of the General Staff.

The Compendium of the Military History of Chile will be a complete work covering every campaign from that of Lautaro to the close of the Civil War of 1891.

The description of each war or campaign will include the following points:

I. Causes of the war or political or military objects of the campaign.

The organization of belligerents showing in detail the following:

(1) Military constitution.
(2) Military organization.
(3) Military instruction, tactics and strategy employed.
(4) Military administration.
(5) Armament and munitions.
(6) Sanitary service.
(7) Spirit of the army, military justice, religious service and disciplinary regulations.
(8) The passing of the army from peace to war footing.

II. A general description of the theater of operations, accompanied by a good map.

III. Résumé of the plans of operations.

IV. The operations on land by campaigns.

V. A succinct account of each engagement, skirmish or battle, accompanied by sketches.

VI. Naval operations.

Each description or review will have two annexes.

Annex I—*Bibilography,* which will consist of a list

of the books and pamphlets that refer to the war or campaign reviewed.

Annex II—*Archives.* This will be an enumeration of the unprinted documents that relate to the subject reviewed.

—Military Policy of

[Our Reserves. Their Military Value and How We May Increase Their Military Efficiency. By Capt. M. *Memorial del Ejército de Chile,* Oct, '17. 5800 words.]

The majority of nations whose armies are maintained by conscription have appreciated the necessity for a periodical renewal of instruction for elements of the reserve. It is a mistake to deceive ourselves with statistics and figures in which enter as factors the vigor of the race, the natural disposition of Chileans for war and analogous considerations leading to the belief that homogeneity of civic spirit will in itself save the country in the event of political emergency. The day is past when personal valor and resolution for combat constitute the main desiderata for troops about to be led to confront the enemy. While such qualities are necessary for victory they are valueless without technical training. Technical knowledge is congenital to no one and can not be improvised on the eve of battle.

There are two systems now in use by the various powers for periodical renewal of training; one consists in recalling to the colors after a period of four or five years all conscripts who have been trained during this time for a three months' course of instruction. A general review is given; new methods are inculcated and the training brought up-to-date. The other system provides for an annual mobilization of several of the recently trained classes for a period of three or four weeks. The first system is the more complete, but it is the more costly.

In Chile the Law of Conscription gives the President of the Republic the power to call the reserves for training, but being vague and ambiguous as to form and method this power has not as yet been used by the executive. It is thought that the law should be made more explicit in this respect.

Permanent assignment of military units to particular districts and localities, and the fostering of a closer affiliation between active individuals of units and reservists who have graduated from them, would favor local pride in the service, develop more friendly relations and tend to the perpetuation of the military instruction received by the reservists. Supplies for units should be purchased locally and the people led to regard the military garrisons as "their companies," "their regiments," etc.

There are three dates that are considered opportune for assembling reservists for voluntary review and instruction, namely, the day of the regiment, (probably the day of the patron saint of the regiment.—Ed.); the day of swearing allegiance to the flag, and the day of licensing the annual contingent.

Regarding the relations that should exist between officers of the regular service and reserve officers it is thought that the former should not be exclusive and narrow-minded professionals but that each officer should have a general preparation so broad that, with the keenness of his observation, the solidity of his culture and the thoroness of his education, he should be able to arouse the patriotism and civic responsibility of reserve officers and aspirants, to influence their morals, guide their inclinations, acquaint them with the high concept of duty imposed upon officers with respect to safeguarding the constitution and laws and implant in them the severe code of personal honor of military officers.

A theoretical course in tactics, topography, military history, fortification, etc., lasting some six or seven months, should be given to all aspirants for commissions in the reserve. Before awarding commissions individuals of doubtful value as future troop commanders should be eliminated. Officers' clubs should be thrown open to reserve officers and they should be welcomed at all military assemblages, conferences, schools, etc. Every effort should be made to keep reserve officers in close touch with their brother officers in the active service.

CHINA

—Aeronautics

See
Aeronautics—China

CHINACOTA

[Chinácota, Columbia; a Military Reconnaissance of the City. Capt. Felix Areñas H. *Memorial del Estado Mayor de Colombia,* Jan, '18. 2000 words. 1 map.]

This study and map of the town of Chinácota were made by the author during his leisure time while garrisoned at that place. It is recommended to all officers that they should spend some of their spare hours doing similar work in order to acquaint themselves in peace time with terrain which they might have to operate over in time of war.

Chinácota is the capital of the province by that name, in the Dept. of North Gautander. It is located on a plateau 1925 meters high. There are telegraph and telephone communications, post-offices and various schools in the city. It is a commercial center of some importance being the distributing point for several towns to the north. Commerce reaches its maximum activity during the month of September when there are many fairs. There is a good hospital in the town, operated by the Sisters of Charity.

Hygiene

The locality is amply supplied by springs of pure water. The streets are broad and well kept.

Lines of Communication

A pack road to the north extends to San Jose de Cucuta; a second road passes over the mountains to the east and joins the Great Central Highway. To the west there is another trail which connects with the Pamplona-Cucuta road at El Dianante 25 kms. distant from Chinácota.

Industries

The chief industry is farming. Beans, potatoes,

CHINACOTA—Continued

sweet potatoes, corn, wheat and barley are the most important products of the soil.

Stock raising is carried on to a limited extent. Horned cattle thrive in this district, which offers fine pasture lands. Very few goats and sheep are found due to the climate. Horses, mules, and asses are bred for transport service.

The manufactures, commercial houses, and lodgings are such as would be found in any small South American town.

Three thousand men could be raised in the town for military service. The inhabitants are well united and possess good characteristics. The isolation of this town has given it the good spirit of unity. The men should make very good soldiers.

CHLORINE

See also

ASPHYXIATING GASES

CIVIL WAR (U. S.)

See also

ASHBY, TURNER AND RICHARD

[Manufacturing Development During the Civil War. By V. S. Clark. *Military Historian and Economist*, Apr, '18. 4000 words.]

There is a tendency to attribute to the Civil War the change of the United States from a planting to a manufacturing nation. But the decade immediately preceding 1860 had been one of remarkable industrial progress. Railway extensions, spread of settlement, increasing immigration, and new mineral resources all contributed to the growth and prosperity of the nation, and manufacturing responded to the stimulus.

The Colt Arms Works were probably the finest private establishment of the kind in the world. Arms were manufactured for export even during the continuance of the war. While hostilities were in progress, our works continued to build steamships, locomotives, mills, and power tools for South America and Europe.

The Civil War inaugurated an era of high protective tariff, but the influence on manufactures was mainly felt after the war. The war did not prove a stimulus to unusual technical development. The Bessemer process was not introduced in the United States until 1865. Our heavy ordnance was of cast iron, and field guns of iron or brass. Rodman guns of 15-inch, and later of 20-inch caliber, were made. Twelve-inch armor was being rolled abroad but Ericson could not obtain 1½ inch plates, and not until the close of the war were 5-inch plates obtainable. The plank-like armor of the Confederate ironclads was forged.

The use of machinery was extended by the sudden demand for large quantities of standard goods and the shortage of labor. Sewing machines, boot and shoe making machines, and farm machinery came into much more general use as a result of the war, but no epoch-making improvement or invention resulted. Breech-loading fire arms and machine guns were tendered to the army, but there was much delay in their adoption.

The North experienced little dearth of material except cotton. There was a temporary shortage of coal, not as serious as that of this year. Large stocks of cotton had been laid in by northern mills just before the war, and this was supplemented to some extent from various sources, and some cotton mills kept going thruout the war. In general about half the cotton machinery was idle. The woolen manufactures developed as cotton fell off, more than doubling during the war.

The manufactures established in the South during the war were largely of emergency character. Manufacturing profits were very high in both the North and South. (The author questions whether the manufacturing developments were anything beyond the outgrowth of natural inter-panic conditions, but does not answer his own question.)

—Hospitals in

See

HOSPITALS—IN CIVIL WAR (U. S.)

CLIMATE, Military Aspects of

See also

WEATHER, MILITARY ASPECTS OF

[The Weather and the War. The Western European War Zone. By Robert De C. Ward, Professor of Climatology, Harvard. *Jour. Military Service Inst. U. S.*, Sept-Oct, '17. 4500 words.]

Since the first few weeks of the war there have been no extended general movements of troops on the western front. It has been essentially trench warfare, virtual stagnation. In this sort of warfare weather is not such an important factor but, if aviators cannot fly or cannot see; if artillery fire has to be by dead reckoning; if the infantry have to scramble out of muddy and slippery trenches; if trenches and shell holes are filled wth water, surely these are insuperable obstacles in the way of a quick and successful advance. In the use of airplanes, airships and searchlights, warfare is far more dependent upon meteorological controls than ever before. The movement of heavy guns, armored automobiles and tanks is blocked by snow and deep mud as effectively as when lighter guns and draft animals were used.

Summer on the western front is not a season of generally heavy rains nor of intense heat, altho there have been spells when men suffered from the glare of the sun and the water supply had to be carefully considered. Heavy rainfalls have at times soaked the ground and made it slippery so that active fighting was suspended. During dry spells, the dust raised by bursting shells, by marching troops, and by traffic has made it impossible to determine the exact position of friend or foe. Early morning fogs have sometimes made it difficult for infantry units to keep in touch, and for the gunners to follow their advance. Haze has played its part in causing low visibility and making artillery observation inaccurate. However, the summer months have been those of most active movements.

Fighting conditions are less favorable in the autumn; weather changes are more frequent and more violent,

snow and sleet begin to fall, and the rain is more chilling. Observation becomes more difficult owing to clouds, a mist or fog. The mud of Flanders has proved a serious handicap. As the storms are frequent and drainage poor, the soil is quickly waterlogged and trenches made uninhabitable. The frequent weather changes have given constant trouble. A few days of cold, freezing the ground, facilitate the movement of troops; then a mild spell, perhaps with rain and the roads and fields are turned into quagmires.

Winter weather is autumn weather exaggerated: more storm, more mist, more snow, more cold, more wind, more cloud. Day after day, the soaking rains, wet snows, low clouds or dense fogs have forced a practical suspension of military operations. The snow in the lowlands is not deep, and seldom remains long on the ground, nevertheless, individual snowstorms have made trouble while they lasted.

Spring weather is intermediate in its characteristics between the stormier, colder, more disagreeable conditions of winter and the calmer, more settled weather of summer. Early spring still has wintry spells of low temperatures, heavy rains, sleet and late snows, with much deep mud and cloud and many unfavorable days for airplane observation, for artillery fire and for military movements.

[The Weather and the War. The Eastern European War Zone. By Robert De C. Ward, Professor of Climatology, Harvard. *Jour. Military Service Inst. U. S.*, Nov-Dec, '17. 4250 words.]

In comparing the western and eastern theaters of war in the colder months, both have advantages and disadvantages from a military point of view, but the temperatures average a little higher in the west. Belgium and France are likely to have somewhat more rain and sleet than eastern Germany, Austria and Poland. The cold spells are of shorter duration in the west, and are usually more frequently interrupted by thawing. In the eastern theater there is somewhat greater and more continuous cold, but the weather is more settled and the ground continuously frozen. In Belgium and eastern France the Germans have found themselves in winter conditions slightly milder than those of their own country farther east. If the Germans had penetrated far into Russia, or the Allies into Germany, both would have experienced a gradually increasing severity of cold.

In the autumn, rains make serious trouble, deep mud greatly hampering the movements of troops and particularly, of the heavy guns and motor trucks. The Russian guns and wagons are light and especially designed for this but those of the Germans are heavy and are moved with great difficulty.

The extreme autumn cold caused the Germans and Austrians to suffer great discomfort as they were not clothed for such weather. The Russians, however, suffered little or none at all. The desperate energy of the German drive in the summer of 1915 had one of its main springs in the necessity of reaching a decision before the autumn rains and winter cold set in. The Germans did not succeed in reaching a strong line on which to entrench for the winter.

Large scale operations are not to be expected during the winter, for altho the marshes freeze over they are always treacherous. The partial failure of Von Hindenburg's advance in East Prussia early in February, 1915, was due to the treachery of these marshes as they delayed his left flank and then greatly hampered the German pursuit. As long as the marshes were not frozen no special fortifications were needed, and neither side could well advance.

Spring thaws cause floods and the necessary abandonment of low-lying positions; the roads become almost impassable. This condition prevents any possible spring drive on this front unless the troops occupy high ground as did the Germans in the spring of 1916.

The summer heat brings no discomfort but as in the spring, heavy rains cause flooded marshes and impassable roads. The heavy rains in June, 1915, held up the German advance and allowed the Russians to fall back slowly, strengthening each position. The floods have caused withdrawals by both sides from time to time, the last being that of the Russians near Kalusz.

[Rainfall and Battles. By R. D. Ward. *Geographical Review*, Feb, '18. 300 words.]

The widespread popular notion that gunfire produces rain will not die. It has come prominently to the front again since the beginning of the present war. This in spite of all that scientific writers have done and are doing to overthrow the belief. Mixture of warm and cold air masses, as the result of explosions, might cause cloud formations, or even a slight drizzle, but never any considerable precipitation. Water vapor resulting from chemical reaction could not be a source of precipitation. An enormous amount of explosive would be required to produce even a small rainfall in this way, and even then all the hydrogen in the explosive would have to become water vapor and condense at once (21,750 tons of melinite per square mile to produce 1 millimeter). Electrical action, resulting from the ionization produced by high explosives, and an excessive number of dust particles arising from the same source, can do more than accelerate a precipitation which would be necessitated sooner or later by the progressive cooling of the air. A careful study of the amounts and the frequency of rainfall in France since the war began fails to show any effects of the gunfire.

CLOTHING, Military

See
Uniforms

COAST ARTILLERY

See also
Field artillery—Heavy—Instruction and training

Spain

[Effectiveness of the Matériel in Our Coast Defense Forts. Julio Maldonado. *Memorial de Artilleria*, Feb, '18. 2400 words. 5 tables.]

COAST ARTILLERY—Continued

In obtaining an accurate fire from artillery, the battery commander is the directing power. During the period in which the target is being bracketed, the efficiency of the matériel is not a primary consideration. The contrary occurs once the target is located. Then the primary considerations are rapidity of fire, precision and power both of percussion and explosion. All these conditions depend entirely upon the matériel—pieces and ammunition.

Five tables are shown, one for percentage of precision of various types of guns, one for rapidity of fire in rounds per minute, one for relative power of explosion and percussion in meter tons, one for coefficients of absolute efficiency, and one for coefficients of relative efficiency.

By reference to the tables it is found that the most accurate pieces are the models '87 and '80 Krupp 30.5 cm. pieces. In ranges under 8000 meters, the C. Ac. 26 cm. Krupp is the most accurate gun.

Further comparisons may be made by glancing at the following tables.

REGULATION ARTILLERY—PRECISION

X.	C.Ac. 30.5 cm. Md. 1887	C. Ac. 30.5 cm. Md. 1880.	C. H. E. 30.5 cm.	C. Ac. 26 cm. Md. 1888	C. H. E. 24 cm.	C. H. E. 21 cm.	C. H. E. 15 cm.	C. Ac. 15 cm. T.r.	O. H. S. 30.5 cm. First sector	O. H. S. 30.5 cm. Second sector	O. H. S. 24 cm. First sector	O. H. S. 24 cm. Second sector	O. H. S. 21 cm. First sector	O. H. S. 21 cm. Second sector
m.	%	%	%	%	%	%	%	%	%	%	%	%	%	%
Muzzle..	100	100	100	100	100	100	100	100	100	100	100	100	100	100
1,000	100	100	100	100	100	100	100	100	100	"	100	"	100	"
2,000	100	100	99	100	100	100	99	100	86	"	86	"	81	"
3,000	98	96	86	96	91	84	71	96	50	"	46	"	41	"
4,000	80	68	58	68	59	58	44	75	29	"	24	"	21	"
5,000	54	47	37	48	36	35	23	47	17	"	13	"	12	"
6,000	37	29	23	27	22	21	18	25	13	12	8	9	7	8
7,000	25	20	17	18	16	13	8	16	8	10	5	8	5	7
8,000	18	14	10	12	9	9	5	10	5	8	3	6	2	5
9,000	13	9	8	8	7	5	"	6	"	"	"	"	"	"
10,000	10	7	6	6	4	3	"	4	"	"	"	"	"	"
11,000	7	5	"	4	3	"	"	3	"	"	"	"	"	"
12,000	5	"	"	3	"	"	"	2	"	"	"	"	"	"
13,000	"	"	"	"	"	"	"	1	"	"	"	"	"	"

Target 150 x 20 x 8 meters on water. Centered Fire z = diversion p.p. Maximum charge in shells.

REGULATION ARTILLERY—POWER

X.	C.Ac. 30.5 cm. Md. 1887	C. Ac. 30.5 cm. Md. 1880.	C. H. E. 30.5 cm.	C. Ac. 26 cm. Md. 1888	C. H. E. 24 cm.	C. H. E. 21 cm.	C. H. E. 15 cm.	C. Ac. 15 cm. T.r.	O. H. S. 30.5 cm. First sector	O. H. S. 30.5 cm. Second sector	O. H. S. 24 cm. First sector	O. H. S. 24 cm. Second sector	O. H. S. 21 cm. First sector	O. H. S. 21 cm. Second sector
meters	metric tons	metric tons	metric tons	metric tons	metric tons	metric tons	metric tons	metric tons	metric tons	metric tons	metric tons	metric tons	metric tons	metric tons
Muzzle.	7,720	6,569	5,180	3,941	2,931	1,888	608	1,423	1,621	1,621	875	875	591	591
1,000	6,817	5,802	4,170	3,396	2,389	1,508	436	1,141	1,401	"	740	"	494	"
2,000	6,040	5,149	3,400	2,930	1,926	1,244	322	909	1,184	"	643	"	431	"
3,000	5,354	4,596	2,886	2,558	1,540	1,040	247	730	1,156	"	572	"	386	"
4,000	4,730	4,133	2,554	2,267	1,289	869	206	582	1,084	"	528	"	346	"
5,000	4,204	3,732	2,265	1,994	1,150	731	180	467	1,030	"	498	"	320	"
6,000	3,746	3,405	2,122	1,798	1,051	633	161	380	985	1,180	475	592	304	386
7,000	3,349	3,143	1,996	1,660	956	565	149	316	963	1,139	468	576	294	365
8,000	3,058	2,941	1,873	1,574	895	528	142	272	970	1,100	468	544	297	339
9,000	2,843	2,811	1,750	1,500	831	490	"	248	"	"	"	"	"	"
10,000	2,700	2,700	1,640	1,455	761	473	"	234	"	"	"	"	"	"
11,000	2,606	2,606	"	1,428	725	"	"	227	"	"	"	"	"	"
12,000	2,545	"	"	1,428	"	"	"	223	"	"	"	"	"	"
13,000	"	"	"	"	"	"	"	222	"	"	"	"	"	"

REGULATION ARTILLERY—RAPIDITY OF FIRE

X.	C Ac. 30.5 cm. Md. 1887	C. Ac. 30.5 cm. Md. 1880.	C. H. E. 30.5 cm.	C. Ac. 26 cm. Md. 1883	C. H. E. 24 cm.	C. H. E. 21 cm.	C. H. E. 15 cm.	C. Ac. 15 cm. T.r.	O. H. S. 30.5 cm. First sector	O. H. S. 30.5 cm. Second sector	O. H. S. 24 cm. First sector	O. H. S. 24 cm. Second sector	O. H. S. 21 cm. First sector	O. H. S. 21 cm. Second sector
	Minutes	Minutes	Minutes	Minutes	Minutes	Minutes	Minutes	Minutes	Minutes	Minutes	Minutes	Minutes	Minutes	Minutes
Interval between rounds	3	3	3	2	2	2	1	0.25	3	4	2	3	2	3

REGULATION ARTILLERY—COEFFICIENTS OF RELATIVE EFFICIENCY

X.	C.Ac. 30.5 cm. Md. 1887	C. Ac. 30.5 cm. Md. 1880.	C. H. E. 30.5 cm.	C. Ac. 26 cm. Md. 1883	C. H. E. 24 cm.	C. H. E. 21 cm.	C. H. E. 15 cm.	C. Ac. 15 cm. T.r.	O. H. S. 30.5 cm. First sector	O. H. S. 30.5 cm. Second sector	O. H. S. 24 cm. First sector	O. H. S. 24 cm. Second sector	O. H. S. 21 cm. First sector	O. H. S. 21 cm. Second sector
m.														
Muzzle..	3.6	3.0	4.2	2.2	1.7	0.7	0.2	1	0.6	0.5	0.3	0.2	0.1	0.06
1,000	3.9	3.3	4.2	2.2	1.7	0.7	0.2	1	0.6	"	0.3	"	0.1	"
2,000	4.4	3.7	4.3	2.4	1.7	0.7	0.2	1	0.6	"	0.3	"	0.09	"
3,000	4.9	4.1	4.1	2.6	1.7	0.6	0.1	1	0.4	"	0.2	"	0.05	"
4,000	5.7	4.3	4.0	2.6	1.4	0.6	0.1	1	0.4	"	0.1	"	0.04	"
5,000	6.8	5.3	4.3	2.9	1.6	0.6	0.1	1	0.4	"	0.1	"	0.04	"
6,000	9.7	6.7	5.5	3.8	1.9	0.7	0.1	1	0.6	0.5	0.2	0.2	0.05	0.05
7,000	11.2	8.4	7.7	4.5	2.7	0.7	0.1	1	0.6	0.9	0.2	0.2	0.07	0.08
8,000	13.0	9.4	7.6	4.9	2.7	0.7	0.1	1	0.7	1.2	0.2	0.4	0.08	0.09
9,000	14.0	9.6	10.5	5.4	3.0	0.7	"	1	"	"	"	"	"	"
10,000	16.0	12.0	10.5	6.0	3.0	0.8	"	1	"	"	"	"	"	"
11,000	16.0	12.0	"	"	"	"	"	1	"	"	"	"	"	"
12,000	16.0	"	"	"	"	"	"	1	"	"	"	"	"	"
13,000	"	"	"	"	"	"	"	1	"	"	"	"	"	"

REGULATION ARTILLERY—COEFFICIENTS OF ABSOLUTE EFFICIENCY

X.	C. Ac. 30.5 cm. Md. 1887	C. Ac. 30.5 cm. Md. 1880.	C. H. E. 30.5 cm.	C. Ac. 26 cm. Md. 1883	C. H. E. 24 cm.	C. H. E. 21 cm.	C. H. E. 15 cm.	C. Ac. 15 cm. T.r.	O. H. S. 30.5 cm.		O. H. S. 24 cm.		O. H. S. 21 cm.	
									First sector	Second sector	First sector	Second sector	First sector	Second sector
m.														
Muzzle.	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1,000	0.88	0.88	0.80	0.82	0.81	0.79	0.72	0.80	0.85	"	0.86	"	0.82	"
2,000	0.80	0.78	0.64	0.70	0.70	0.65	0.52	0.60	0.61	"	0.65	"	0.58	"
3,000	0.70	0.66	0.47	0.59	0.47	0.46	0.29	0.50	0.33	"	0.30	"	0.27	"
4,000	0.50	0.42	0.28	0.37	0.26	0.26	0.14	0.30	0.18	"	0.13	"	0.13	"
5,090	0.30	0.26	0.15	0.20	0.14	0.13	0.06	0.15	0.11	"	0.06	"	0.06	"
6,000	0.20	0.14	0.08	0.11	0.07	0.07	0.03	0.06	0.07	0.07	0.04	0.06	0.03	0.05
7,000	0.10	0.09	0.06	0.07	0.05	0.04	0.01	0.03	0.03	0.06	0.02	0.03	0.02	0.04
8,000	0.07	0.05	0.03	0.04	0.03	0.02	0.01	0.02	0.02	0.04	0.02	0.03	0.01	0.03
9,000	0.04	0.03	0.02	0.02	0.02	0.01	"	0.01	"	"	"	"	"	"
10,000	0.03	0.02	0.01	0.01	0.006	0.007	"	0.007	"	"	"	"	"	"
11,000	0.02	0.01	"	0.01	0.006	"	"	0.005	"	"	"	"	"	"
12,000	0.01	"	"	0.009	"	"	"	0.008	"	"	"	"	"	"
13,000	"	"	"	"	"	"	"	0.001	"	"	"	"	"	"

—Instruction and Training

[National Guard Coast Artillery. Armory Instruction and Preparation for Target Practice and Service Condition. By Lt.-Col. W. Irving Taylor, C.A.C., N.G., N. Y. *Jour. U. S. Artill.*, Sept-Dec, '17. 6500 words. 2 tables. 3 outline maps.]

The Militia Coast Artillery was a direct result of the war with Spain. Rumors of impending bombardments of coast cities were prevalent. At the close of the war, the novelty of the scheme and public interest were believed to promise material aid to recruiting militia organizations assigned to coast artillery duty. On Feb 8, 1900, the 13 Regt., Heavy Artillery, N. G., N. Y., was designated for such duty by proper authority. The attempt to extend this branch of the National Guard did not meet with great success, and in 1915 there were only 440 officers and 7438 enlisted men out of the 711 officers and 17,329 enlisted men which it was hoped and expected that the states would furnish. The troops actually raised bore no correct relation either in number or location to the fortifications at which they must be instructed and where they should serve in time of war. If it were made to the financial interest of the seaboard states to have an adequate and properly organized coast artillery force, such would be forthcoming shortly. At present, legislation does not furnish the necessary authority to insure an adequate force.

Armory Instruction.—Proper armory instruction requires adequate equipment. With single companies scattered about, such equipment proved inordinately expensive. The remedy is a four-company fire command as the smallest unit to be housed in an armory, and this points to the desirability of restricting the coast artillery units to the larger cities.

Instructors.—These have been inadequate in numbers. In 1915 there were but 12 commissioned officers and 28 sergeants of the regular Coast Artillery for the instruction of 440 officers and 7438 enlisted men of the militia, and the difficulty was aggravated by the fact that the militia companies were widely scattered. The services of the sergeant instructors are of the greatest value, and an adequate number of them and of commissioned instructors should be provided.

Rated Men.—Even with equipped armories and sergeant instructors, there was a dearth of rated men in the militia. The substitution of an oral for a written examination in 1916 resulted in a greater number of qualifications.

Enlisted Specialists.—The hope for an abundance of enlisted specialists proved abortive, because the trades in civil life offered no near approximation to this rating. They must be instructed. In 1914 there were but 28 enlisted specialists of all grades.

Commissioned Officers.—The Coast Artillery militia should always be on a war footing, instantly ready for service. This requirement is more severe than in any other arm of the militia, and in no other arm have officers been required to take examinations set by the War Department. Young men just out of college make the best material, but they can hardly afford to give the time. The result is a chronic shortage of officers, and the commissioning of many inefficient and incapable men. Those who have the mental capacity and equipment cannot afford the time until their financial status has reached the stage where they can take leisure from business. There are few such in the militia.

It is possible to give a lesser degree of training, insufficient for independent command but sufficient for work under supervision and guidance. This points to the elimination of theoretical instruction in large measure, and limitation of instruction to the practical side. If the militia officer cannot attain the standard of the regular service, he should receive a less degree of training of practical character. Target practice has a different meaning for the militia than for the regular troops. More attention should be devoted to practice under war conditions, and less stress placed on figures of merit, ballistic data, and analyses of results.

—Matériel—Mortars

See also
MORTARS

—Range Finding

See also
COAST ARTILLERY—TARGET PRACTICE

—Target Practice

[Range Data Present and Future. Honorable Mention, Essay Competition of 1916. By 1st Lt. Oscar Krupp, C.A.C., U. S. Army. *Jour. U. S. Artil.*, Sept-Dec, '17. 4000 words. 3 diagrams.]

COAST ARTILLERY—Continued

Methods of fire direction in the Coast Artillery have not been adjusted to the requirements of the new armament or to the new tactics of a modern enemy. Present day target practice conditions are just as antiquated as most of the guns now in use.

We are too slow in putting our guns into action; just a little behind in timing our shots. Three minutes are required to put a gun battery in action, and four minutes are required for a mortar battery. The same time is required to change to new targets.

There are two main points to discuss: the inexcusably long delay in furnishing data to the emplacements for opening fire, and the inability to follow a fast or changing target. These conditions may prove disastrous in an engagement, and they can be remedied by reducing the observing interval.

About six years ago, the 15-second interval was in use, but the system was too cumbersome to be applied to that interval, and the 30-second interval was introduced. At the present time, the set forward point is plotted on the plotting board. The actual gun range of this point is corrected and sent to the time-range board. Then by further interpolating on the time-range board, the data is obtained for setting the range. The number of successive operations is too great, and better results can be obtained only by simplification, since a long time interval is required to perform the necessary operations.

With the present system, omitting all operations which can be carried on independently of plotting, there are still the following:

1. Azimuths from base end stations are set by the arm setters.
2. Intersection of the arms is indicated by the plotter.
3. Primary and secondary arms are moved clear of the track.
4. The plotter measures and calls the travel in yards during the last interval.
5. An assistant calls off the set-forward travel.
6. The set-forward point is located and plotted on the plotting board.
7. The plotter brings up the gun arm and reads the actual gun range.
8. The range board operator sets the actual range on the ruler.
9. The corrected range is read and sent to the time-range board.
10. The corrected range is plotted on the time range board.
11. The time-range track is predicted ahead.
12. At the proper time the T-square is set by the aid of a stop watch.
13. The set-forward corrected range is noted on the time-range board.
14. The range drum is set.

Such a list of successive and inter-dependent operations requires a long observing interval. The interval can be reduced either by making the operations independent, or by reducing the number of them. But with the present system it may require as much as three minutes to furnish data to the guns to open fire, and the total predicted time (=time between last observation and firing of gun) may be as much as 75 seconds. The average predicted time is 60 seconds, and limits accurate prediction to comparatively straight courses, or at least to low speeds.

It should be possible to track the enemy at all times, whether on straight or zig-zag course, and to do so it is necessary to observe oftener and to plot oftener. The prediction time must be reduced from 75 seconds to not more than 15 seconds. Such a reduction would greatly reduce the time necessary to open fire, and equally increase the hitting power of the battery in the early minutes of an action when hits have such great moral value. (Diagrams are here given to show how much more accurate prediction results from a short observing interval, particularly when the target is moving at greater speeds.)

The two most serious defects of the present system, and which should be remedied immediately, are:

1. Excessively long time taken to furnish data to the emplacement for opening fire.
2. Inability to track a fast target on a variable course.

To remedy these defects, the system must be simplified. The time-range board should be eliminated or transferred to the plotting room. Frequent setting of the range on the range drum will show the time-range relation. Such setting will occupy less than five seconds.

In the plotting room, the process of obtaining the set-forward corrected range can be accomplished in two ways—one by quickly locating the set-forward point on the plotting board by some mechanical device and reading the corrected range off the gun arm; the other is by plotting the actual gun range on a time-range board and locating the set-forward corrected range on the T-square. Until some means are devised, or device invented, for locating quickly and accurately the set-forward point on the plotting board, the time-range board method must be resorted to.

"In using the principle of the time-range board, it is only necessary to obtain the actual gun range of the last plotted point, requiring about six seconds. This actual gun range is plotted on a small, accurate time-range chart or slate located in the plotting room. The T-square should be a sliding range ruler. The range correction is applied to this ruler in a manner similar to that formerly in use on the gun arm. The correction for predicted time and time of flight is obtained by the 'time displacement' between the last vertical time line and the left reading edge of the corrected range ruler. This is accomplished by a range-time-of-flight scale on the top edge of the T-square. The set-forward corrected range can now be sent to the emplacements every interval, in time to be set on the range drum before the next bell."

The number of successive operations is thus reduced to five:

1. The azimuths from the base end stations are set by the arm setters.
2. The plotter brings up the gun arm and reads the

actual gun range.

3. This actual gun range is plotted on the time-range board.

4. The corrected range is sent to the guns.

5. The range drum is set.

With this small number of operations, a short observing and a short prediction interval can be used, thus shortening the time necessary to open fire and making it possible to track a fast target on a variable course.

COAST DEFENSE

See also

COAST ARTILLERY
UNITED STATES—COAST DEFENSE

COLLEGES

—Military Training in

See

EDUCATION, MILITARY—IN SCHOOLS AND COLLEGES

COLOMBIA

—Army

[Observations on the Information Submitted by the Commanders of the 2nd Brigade Mil. Dist. *Memorial del Estado Mayor* (Colombia), Jan, '18. 1200 words.]

[A critique by members of the Colombian General Staff of a series of road sketches made by the officers of the 2nd Brigade.

The sketches cover the 2nd Brigade district. The critique brings out the fact that Colombian officers are poorly trained in map making.]

—Military Topography of

See aso

CHINACOTA

[Lines of Communication Chicoral-Ibagué-Cantago-Cali. By Agustin Carvajal. *Memorial del Estado Mayor de Colombia,* Sept, '17. 1600 words.]

(A continued article based on a military reconnaissance of the lines of communication in the republic of Colombia. Each road is taken up in detail as it is gone over, giving the names of the towns and villages passed thru, important military and geographic features noticed, altitude of various points, the ability of the country to support troops—the character of the people—the usual temperatures—amount of water, etc.)

The country is full of mountain streams and almost every district seems to have an electric power plant of some sort. In addition to the railroad service and the means of travel over roads, there is a "jitney" service between Pasodi Commercio and Cali—the former is a port on the Cauca River. Transportation on the Cauca River is supplied by power boats of various sorts, each town on the river having its own wharf for loading and unloading freight.

In general, the people are agricultural and have done very well in clearing the country and making it productive. They are intensely hospitable people.

[Roads. The Chicoral-Shaguè-Cartago-Cali Routes. By 2d Lt. A. Carvajal. *Memorial del Estado Mayor de Colombia,* Oct, '17. 1400 words.]

(A conclusion of the article in the September Number on the Chicoral-Cali routes. It is a very complete report on an extensive road reconnaissance of these routes giving all military information available. This article dwells especially on the rail and water communications of the city of Cali [32,000 inhabitants] on the Cauca River.)

COMBAT

See also

AERONAUTICS—COMBAT
INFANTRY—TACTICS—COMBAT

COMMAND OF TROOPS

See also

OFFICERS—INSTRUCTION AND TRAINING (Article: "Leadership and Military Training")
STAFF—GENERAL STAFF

[Military Character. By Vice-Admiral Wm. S. Sims, U. S. Navy. *Jour. R. U. S. Institution,* Nov, '17. 10,000 words.]

In conclusion, the author reviews the article and briefly enumerates a few of the most important things that should always be done, and a few of those that should always be avoided, in the effort to promote loyalty and initiative in those for whose training we are responsible.

1. Always let your general mission be understood. The American is willing to co-operate when his intelligence is enlisted.

2. Invite suggestions and consider them carefully.

3. Hold conferences for this purpose. I have known valuable improvements to result from such suggestions from junior officers and enlisted men. Moreover, consulting subordinates greatly increases their self-respect, and tends strongly to promote initiative and inspire the team spirit, which is another name for loyalty.

4. Make use of competitions where practicable. It promotes interest in even the more strenuous drills.

5. Explain the necessity for constant drill.

Usually the recruit does not understand why he is subjected to daily drills after he has thoroly learned his duties. He therefore questions the wisdom of expending considerable perspiration each day in performing these arduous duties over and over again, and, not understanding, becomes dissatisfied. This is a natural result of the intelligence of our men. They are accustomed to understand what they are doing and why they are doing it; and experience has shown that when they understand this matter they will drill enthusiastically. It is therefore essential that officers understand and explain that the object of drill is not simply to learn how to perform the various necessary operations, but to repeat them so often and so continuously that these operations will eventually be performed subconsciously.

6. Be sure you know thoroly the subject of all your instructions. Knowledge of your job always commands respect from those associated with you.

7. Encourage your men to come to you for information on any subject, and take pains to look it up

COMMAND OF TROOPS—Continued

and supply it. Help them in anything they want to study.

8. Train your men in initiative by "putting it up to them" on all proper occasions, and explain why you do it.

9. When you have inspired loyalty in all of your men, more than half your troubles will be over, for thereafter initiative will develop rapidly if you give it intelligent direction and adequate opportunity.

10. Maintain discipline with the minimum reference to higher authority. If you succeed in establishing the relations indicated by the above, you will hardly ever need to appeal to higher authority.

11. Always be considerate of inexperience. When admonition will correct a small fault, it is almost always a mistake to inflict punishment.

12. Be absolutely just in all your dealings with your men. Hardly anything tends more strongly towards loyalty. All kinds of men respond to the "square deal."

13. Avoid harshness in manner or in methods. Let admonition or punishment be inflicted in sorrow, not in anger. Always give the man the benefit of any reasonable doubt.

14. Never destroy or decrease a man's self-respect by humiliating him before others. If his self-respect is destroyed his usefulness will be seriously diminished.

15. Do not let the state of your liver influence your attitude toward your men.

16. Do not inflict severe reprimands for minor faults. Often an explanation of the result of faults is the most effective means of correcting them. Take pains to explain to the men what the effect would be upon the whole organization if faults were not corrected.

17. Remember that the purpose of all forms of punishment is correction—a correction of the offending inidividual and a warning to others similarly situated. Never let the spirit of revenge have any influence upon your decision in disciplinary matters.

18. Before you take any action, or adopt any line of conduct, consider carefully its effect upon the man's loyalty, upon the development of his character, and its effect upon the discipline of the organization.

19. Remember that every single one of your official acts exerts a certain influence one way or the other.

20. Avoid hostile criticism of authority, or even facetious or thoughtless criticism that has no hostile intent.

[Evolution of Intellectual Activity in the Commanders of Small Fractions of Troops. *Memorial del Estado Mayor* (Colombia), Jan, '18. Collected from various sources. 6000 words.]

At present the infantry section is the unit upon which all movements are regulated; in this, it has replaced the company, and this change has brought with it a necessary revolution in the education of the chief of section.

As long as the section commander was directly under the captain and simply an executor of the captain's commands, his most necessary qualities were obedience, and strictness in discipline.

Once in command of his small force the section chief is beset by a thousand thoughts at a time—picking out temporary stopping points, always at a decreasing range from the enemy; reaching the enemy rapidly in the best formation; seeking the best routes, indicating the kind of fire and controlling it; watching the ammunition supply; maintaining the liaison with his captain, etc., etc. His duties require the use of initiative, intelligence, and adaptability.

The chief of section is also kept extremely busy before and after combats or battles, when on the march or in garrison.

In any of the many small tactical problems which invariably present themselves in campaign, the chief of section will be either executing an order, or acting on his own initiative. In either case the essential thing is not to lose sight of the objective point to be reached, or the mission to be executed. With an additional knowledge of the enemy's possible obstacles, nature of the ground, etc., the problem can be easily solved.

If the chief of section has the ability to choose quickly his decision can be rapidly made. It only remains, then, to put his decision into clear and forceful language in the form of an order.

Leaders of men should constantly put small problems to themselves simply as a matter of intellectual discipline. It is not a question of being able to do this, but ordinarily a question of wanting to do so. A lively, wide-awake mind will seek occasions to act, instead of awaiting orders.

Intellectual activity is cultivated by drills with or without complete organizations, in the field, and by the use of maps.

For a drill to be effective it must be methodically directed. An instructor should prepare himself diligently beforehand so that he can dedicate himself entirely to instruction when he is on this duty. His duty does not consist in going around silently among the maneuvering groups waiting for a mistake to correct—he must act as an educator—animating the students and giving interest to the drill by intelligent interruptions.

Any pause in the drill will be a true rest period for the men and will not be used for any other purpose. By the variety and the rational sequence of the subjects studied the instructor can force attention and sustain interest. In order to keep the brain active drills and maneuvers should be given together.

The old expression, "The attempt to understand is never necessary," is no longer a true military aphorism, with the voluntary discipline of to-day. The chief of section should always be on the alert—he should have the question "Why" firmly imbedded in his brain and whenever any theory is discussed or opinion offered he should think about it and form his own opinion thereon. Above all he should try to deepen and renovate his thoughts. His superiors should not have to drive him to work—he must always be the first to learn—to know—and to act.

Lazy minds inevitably fall down before routine work, they are directly opposed to the offensive idea.

The chief of section has a very limited field of military activity and what is lacking in extent should be made up by thoroness in what is done. A definite object should be kept in mind and should be gained by applying ideas, which, after due thought, seem the best. It is not correct to act in a certain way because that is the way it has always been done. Circumstances are constantly changing. At the same time one should not act in a certain manner simply because this particular method of procedure has never been adopted by anyone else. One should not try to distinguish himself or act in a spirit of contradiction. If it is decided that the method in question is the best one—use it.

Avoid doing the same thing over and over many times. Drills and maneuvers, if not carried out in the proper spirit of activity, are the most fertile fields for intellectual decay.

Upon returning from maneuvers or drills the section commander should devote himself to the development of his faculties as his time permits. The well directed reading of selected works of history, the memoirs of great leaders, will open up one brain section at least and the opening of a part of the brain is bound to affect the entire mind.

Mental exercise is necessary as a relief to the purely physical exercise of drills.

Part Two

As combat is a battle between different morales, the chief of section must be prepared in time of peace in order that in battle he can sustain the morale of his troops and break down the adversary's morale so that advantage may be taken of this break-down to carry out the pursuit.

The best way of securing a moral superiority over the enemy is by taking the initiative and maintaining it. An army which waits for the enemy's blows immediately shows itself to be morally inferior. An army which does not take the offensive voluntarily shows a lack of faith in its own offensive powers. Such a state of mind cannot bring victory.

The assailant who advances in spite of the enemy increases his strength as he goes. The further he advances the greater becomes his moral superiority.

The spirit of duty must be so trained that it will be able to vanquish many dormant instincts which are only brought out in a man during the physical suffering of a long campaign. These instincts of fear and self-preservation are rapidly brought out by hunger, loss of sleep, nervousness and mental depression. The chief of section and the platoon leaders are there to take care of such individuals as may show signs of weakness.

In battle the company very soon separates into platoons and the platoon leader becomes the all important officer. He has a compact block of men under his own personal influence—and as the dangers increase so must this influence grow. The increasing number of dead and wounded comrades will cause the soldier great mental depression. And herein lies one of the moral factors of the advance where only the living men fight, whereas in the defense one fights beside the dead.

The platoon leader never allows his nervousness to be felt by his troops; his coldbloodedness and bravery make converts of the weak hearts in the platoon. He will remember that fear is one of the greatest aids to discipline, because when everybody is exposed each one imitates and follows the first man who gives a good example or a proper command.

There are many other impulses which affect the modern soldier. For instance, if he loves his leader he will want to share all dangers with him and never abandon him. Pride also is a great factor in keeping a man up on the line.

The only discipline which is morally strong enough to resist the fear and suffering of modern battles which last for weeks, is a self-imposed voluntary discipline. It must be remembered that there will be a lot of men who, tho voluntarily disciplined, when the platoon is deployed over 80 or 100 meters, will want to fall back behind convenient obstacles while their comrades advance and in these cases the platoon leader will have to apply his moral club with as much force as the officers in Frederick the Great's army used their wooden ones.

The state of nervous over-excitement of a section or platoon in reserve or in support is greater than that of a platoon in the firing line, because the former advance over ground covered with their own dead and wounded while the latter never see their dead or wounded comrades. It has often happened that the first troops to start a rout were those furthest from the firing lines. Units which are kept behind the lines as reserves must be under chosen leaders who can dominate them and keep their morale intact.

The reserves move up to reinforce the firing line and troops are mixed; platoons lose their identity; non-commissioned officers and lieutenants are the ones most exposed and consequently suffer the greatest casualties—the platoon leader will find himself commanding strange men without the help of many non-coms. Discipline takes on an impersonal character when soldiers are required to obey the orders of a man whom they do not know. This requires on the platoon leader's part firmness, energy, and at times brutality. He must instantly dominate the strange soldiers.

In order to dominate others a man must first learn how to control himself. The man who remains master of all his forces in any situation is a man of superior character—the platoon leader then must be a man of superior character.

—Qualifications for

[Brains and the Man. By T. C. *United Service Mag.*, June, '18. 3500 words.]

Napoleon considered endurance and discipline to be of greater military value than brains. So much emphasis has lately been laid on the importance of brains in connection with leadership in the field that there is danger that they may be regarded as the sole requisite for higher commanders, relegating such qualities as knowledge, balance, and the like, to the background. It may seriously be asked whether brains are indeed the important qualification for success as the leader of a subordinate formation in the field.

Military lessons of past wars are now at a discount,

COMMAND OF TROOPS—Continued

but the lessons of the present war are not yet available, so we may well turn to the wars of the 19th century for information. Twice within a century have great armies been raised under conditions analogous to those under which the British armies have been raised in this war. The experiences of the French Revolution and the Napoleonic wars, and of the American Civil War may therefore shed some light on the subject.

(Follows a brief discussion of the military characteristics of Jourdan, Hoche, Marceau, and Moreau, leaders in the French Revolution; of Napoleon's four non-professional marshals, Brune, Mortier, Bessières, and Suchet; and of four "amateur" generals of the American Civil War, Logan, Terry, Gordon, and Forrest.)

From this discussion it appears that in the wars mentioned, men who rose from the ranks or without previous experience to high command seem to have gotten along well enough without "brains." Military knowledge is one of the highest claims for leadership in the field, and intellectual superiority is not a sufficient substitute for it. Energy, dash, daring, resolution, force of character, loyalty, and tact, rather than high intelligence, were the characteristics of the non-professional leaders who achieved distinction in the Revolutionary, Napoleonic, and American Civil Wars. The marshals and generals who rose from the ranks were men of adventurous character, of action and enterprise rather than intellectual distinction, and in more than one instance they were noted for the time spent in hard study of the theory of war.

Modern war is not less complicated than those of earlier days, and a grasp of essential principles is necessary to those who aspire to command in the field. The army is really a "learned" profession, and the knowledge necessary to handle large bodies of troops in the field is gained gradually, and after close study as well as practice. Worth coupled with military ignorance will always rise slowly.

"In most human affairs intelligence cannot act without a medium of sound knowledge to guide and control the judgment; but in the field, and this is perhaps not generally grasped, neither knowledge nor intelligence will avail unless the mind is so firmly balanced and the character so resolute, that these can be applied in the most disadvantageous and trying circumstances of danger, hardship and fatigue."

A cool head is the most important characteristic for leadership. Without it brains will not function and knowledge cannot be applied. Brains and knowledge are useless if the mind becomes confused by excitement and danger. But a cool head is of no great value without knowledge, and force of character, daring, and energy are required to execute what has been decided.

The greatest leaders—Alexander, Hannibal, Cæsar, Nelson, Napoleon, and their like—combined brains with the other qualities and qualifications which are known as genius.

COMMISSION

See also

OFFICERS

COMMUNICATIONS

See

SIGNALLING

COMPULSORY MILITARY SERVICE

See also

UNITED STATES—MILITARY POLICY OF—COMPULSORY MILITARY SERVICE

CONCENTRATION CAMPS

See

MOBILIZATION—CONCENTRATION CAMPS

CONSUMPTION

See

TUBERCULOSIS

CONVOYS AND CONVOYANCE

[The Convoy System a Real Success. *Sphere,* Mar 23, '18. 200 words. Illustration.]

(The illustration shows a typical North Sea convoy. Eight merchantmen are echeloned in two columns. Between these columns are trawlers, as well as on the outer flanks of the columns. Well in lead is a destroyer followed by a light cruiser. Then follows a destroyer towing a kite baloon. Other destroyers pursue zigzag courses on the outer flanks of the convoy, and the column ends with another destroyer towing a kite balloon. These details are given because they are already known abroad.)

CUPOLAS, Gun

See

FORTIFICATIONS—PERMANENT—AMORED TURRETS

DARDANELLES, Operations at the (1915)

[The Great Amphibious War. By Major-Gen. Sir George Aston, K.C.B. *Army & Navy Gazette and Broad Arrow,* Apr 13, '18. 1150 words.]

The Dardanelles Problem

In order to reach the objective, Constantinople, it was necessary in the first instance to force a passage thru the Dardanelles. The most formidable difficulty to be surmounted was the destruction of the mine-fields and the apparatus on shore for launching locomotive torpedoes at passing ships in the narrow and tortuous channel opposite Chanak. A strong current always sets outwards there, delaying the movement of incoming vessels, and adding seriously to the difficulties of navigation. Mine-sweepers could not work thru the channel unless the batteries were destroyed. Some of these batteries were visible, but many were concealed, and, in addition to the fixed batteries, there were mobile pieces, large and small, which had not been accurately located, and, if so located, could easily be moved to other positions. The topography of the Gallipoli peninsula lends itself to the concealment of troops and guns, and affords facilities for screening them from view and from fire from the sea. There was known to be a considerable Turkish garrison, controlled by a staff of German officers, but it does not seem to have been possible to form any accurate estimate of the number of Turkish troops available. It was subsequently esti-

mated at 300,000. As the mine-sweepers could not destroy the mine-fields unless the batteries, visible and invisible from the sea, fixed and mobile, could first be silenced, and as the heavy ships could not perform this task, the channel could not be used without the help of an army, which must be strong enough to defeat the garrison protecting the batteries, and then to capture or destroy the batteries themselves. The army must be landed upon open beaches, and provided with sufficient transport to carry their food, ammunition, entrenching tools, and other necessary stores. Water supply for a large force was known to present special difficulties. Secrecy, one of the main factors in the success of amphibious operations, was no longer possible. The naval attacks had shown clearly what was coming, and the operations had been freely discussed in the press. It was certain that the landing of the army would be opposed. Lord Kitchener estimated the force required at 150,000.

Loading the Transports

Directly an amphibious operation to secure the passage of the fleet thru the Dardanelles was decided upon, speed was the all-important factor. Every day's delay would make the task more difficult, and here there is one outstanding lesson, which has been taught over and over again by experience in amphibious operations. The transport vessels must be loaded so that the troops, and their stores and land transport, can rapidly be landed in the order that they are required for operations on shore. This lesson was learned by the Americans from the experience of Shafter's expedition to Cuba in 1898. It was learned by us in the Clacton maneuvers in 1904 and we had suffered much inconvenience and delay in former wars from the neglect of this principle, even when the disembarkation of the troops was carried out in friendly harbors, where the vital importance of their being ready to fight directly they were put ashore did not apply. The lesson had been impressed for many years upon army staff officers at the Staff Colleges at Camberley and Quetta, and upon naval officers at the War College at Portsmouth. Officers of both Services had held conferences on the subject, and it was understood thoroly that the time must be calculated from the moment when the embarkation began to the moment when the troops were on shore with all that they needed to fight an action. A few hours saved in a hurried embarkation might lead to a delay of weeks in a disembarkation, because equipment, transport, and stores required for action might be at the bottom of the holds. The embarkation on this occasion seems to have been carried out hurriedly. When a decision to land the army in face of opposition was arrived at, the operation had to be postponed until the transports had been completely unloaded, and loaded again, so as to enable their contents to be landed in the right order. This caused a delay of nearly a month. The most valuable of all the lessons afforded by the Dardanelles example for our future conduct of combined operations is afforded by the use made by the enemy of this month. From their own accounts, it is quite possible that, had the transports been loaded less hurriedly, the landing would have taken place sooner under far easier conditions, and the expeditionary force, if it acted with vigor, might have driven the Turks out of the Gallipoli peninsula. The garrison, under the direction of Field-Marshal Liman von Sanders, completed their arrangements for opposing the landing only just in time to meet the attack. One of the German Staff Officers wrote: "This time" (one month) "was just sufficient to enable the Field-Marshal's uncanny energies sufficient time to get everything in order. If the enemy had only decided to attack a little earlier, Heaven knows how the matter would have ended."

DECORATIONS AND REWARDS, Military

See also

Uniforms (Article: "Army and Navy Uniforms and Insignia")

[Ideas on Recompenses for Military Services. By Major José Fernán de Enriquez y Quíemara. *Memorial de Caballeria,* Dec, '17. 1500 words]

(This article is a study on war medals, and other marks of recognition for gallant and meritorious service.

The following recompenses are recommended, according to the degree of bravery, or the value of the service rendered.

1. Citation in the Order of the Day—with details of the act for which citation is given.

2. Military cross of a class corresponding to the Order of General Merit cross, with red and white ribbon according as the service was rendered in time of war or peace.

3. Cross corresponding to that of the Order of Maria Cristina with red and white ribbons as above.

The author describes these various decorations in detail.)

DEMOLITIONS

See aso

Sapping and mining

DENMARK

—History

See also

Canute the Great

DENTISTRY, Military

See also

Sanitary service—Dental personnel and service

DIRIGIBLES

See

Aeronautics

Germany

[Some Super-Zeppelin Secrets. *Scientific American,* Nov 24, '17. 1500 words. Illustrated.]

A retired French soldier captured the Zeppelin *L-49* when it landed on French soil after combat with a French battleplane. Before the German commander could destroy his craft the French soldier covered him with a shotgun.

The *L-49* is evidently a recent type of Zeppelin intended for scouting at sea and for raiding purposes.

DIRIGIBLES—Continued

The construction shows signs of hasty workmanship and lack of finish, also noticeable in recently captured German airplanes. The *L-49* carries a powerful wireless set, involving no new principles but many novel features of interest.

The super-Zeppelin is commanded from an enclosed bridge, just forward of the wireless room. In order to protect the occupants from the cold and wind, the bridge is provided with a three-ply windshield and a heavy fiber mat. All the controls are at hand, so that the giant airship, like its counterpart on the high seas, can be guided from the bridge. For operating the vertical rudder and the elevating planes, handwheels are provided, much after the fashion of those used on motor boats. An elaborate chart table also forms part of the bridge equipment, as does a control board containing 38 red and white buttons, each of which takes care of the expansion or the contraction of the balloons. Light-weight stools made of three-ply thin wood are used in the navigating room by the crew.

The power plant of the *L-49* consists of five separate units, the largest of which is just aft of the wireless room. Running the full length of the envelope is a narrow gangway which permits the crew to walk from one part of the aerial greyhound to another, giving ready access to any one of the engine rooms. At one point there is a well or tube, formed of balloon fabric, enclosing a light aluminum ladder which leads to a small gun platform on top of the envelope. This platform mounts two machine guns which can be brought to bear on hostile battleplanes attacking the airship from above.

The other power units are contained in bullet-like gondolas or cars which are suspended below the balloon proper, and which are reached from the gangway by climbing down eight-foot ladders. Each of these gondolas contains two engines which drive a single propeller, and the arrangement is such that either engine can be employed separately to economize fuel when full speed is not required.

The envelope of the Zeppelin contains 19 balloons of gold-beater's skin, with ballonets inserted in each one, so as to form an integral member. These ballonets are an essential part of each balloon unit, and serve to take care of the expansion and the contraction of the hydrogen gas, thus maintaining the proper conditions in each balloon regardless of the altitude at which the airship is traveling, the temperature or any other vital factor. The ballonet valves are under the control of the navigator on the bridge, thru the agency of the 38 little white and red push buttons on the control board before him.

Also contained in the envelope are the water ballast tanks, so arranged as to distribute the weight along the entire length of the craft. These tanks are of canvas, and each has a capacity of about 200 quarts. Any desired tank can be drained of its contents from the bridge, and the buoyancy of the Zeppelin can be delicately and readily controlled.

Fuel for the engines is carried in 16 tanks of substantial construction, so piped that any one of the tanks can be used to feed one engine or all the engines. The German constructors have evidently taken every precaution to safeguard their fuel storage and distributing system in order to reduce to a minimum the fire hazard.

Of the other equipment of the *L-49* little can be said at the present writing, due to the complete absence of details. It is known that a parachute was found in one of the engine rooms, suggesting that parachutes are perhaps used by the crew to escape from a doomed Zeppelin. Hammocks were found in considerable number, indicating that the crew rest after the fashion of sailors on board warships. But the chances are that the better part of the instruments and miscellaneous equipment was thrown overboard to lighten the craft when the crew was bending every effort to escape a French battleplane, just before landing.

All in all, the *L-49* is an interesting craft. Still, after the many wild rumors which continually emanate from Swiss sources concerning the wonderful super-Zeppelins being tried out over Lake Constance, the secrets betrayed by the present type are somewhat disappointing. There is no evidence of marvelous bomb-dropping apparatus, tremendous speed, all-powerful armament, gigantic proportions, mist-producing machinery for hiding from enemies, or non-inflammable gas in the place of hydrogen. Again we are led to believe that these things exist mainly in the minds of the Teuton *camoufleurs,* whose chief rôle is to inspire fear among the civilian population of enemy countries.

[The Modern Zeppelin Airship. By L. D'Orcy, M.S.A.E. *Aviation,* Dec 15 '17. 3200 words. Illustrated.]

The capture, by French aviators, of the German naval airship *L-49* on Oct 20 at Bourbonne-les-Bains, lifted the veil of secrecy which has surrounded the construction details of Zeppelin airships since the beginning of the war. The overall length has grown from 158 m. of the ante-bellum airship to 196 m. on the *L-49;* the master diameter has grown from 16.60 m. to 25 m. The cross section is now a 25 sided polygon, instead of a 17 sided one, thus approaching the ideal cross section; the nose is much blunter while the stern tapers to a distinctly conical end. This shape greatly reduces the frictional resistance. The steering gear is of simple design, consisting of symmetrically shaped horizontal and vertical fins and rudders, instead of the multiplane surfaces of the early Zeppelins. All of this results in a material saving of head resistance; in other words a greater speed can be obtained with the same power. The hull is built up as before of duralumin lattice girders of triangular cross section, there being 25 longitudinals and 36 polygonals. The keel, which now runs within the hull, is formed by two main longitudinals, and of an internal longitudinal, situated in the center line of the base, thus forming in cross section the latter A. Rudders and elevators are balanced at about one-third chord length from the leading edge to facilitate manual labor. The careful streamlining of these airships extends to the control arms of the mobile surfaces, which are

quadrant shaped. The outer cover of the hull is made of linen fabric, which on the lower half is dyed a brilliant black by means of a coal tar dope, while the upper half is painted a cloud gray. This camouflage answers the purpose of misleading aviators who may be at a higher level than the airship, while any detection from the ground is very difficult at night since the black underside does not reflect the rays of the searchlights. The nineteen gas bags are made of cotton fabric lined with gold beaters' skin. A strong but light ramie netting, which is trussed to the framework, surrounds each gas bag and prevents it from either chafing against the hull or bulging into the keel. Each gas bag is provided with a spring-loaded safety valve, which opens into a vertical ventilating shaft running to the top of the hull. There were four cars mounted in such a way that the fore and aft cars were situated in the center line of the ship, while the two remaining cars were mounted about amidship, on a common transverse axis, on each side of the hull. The amidship cars served as the engine rooms, each housing a 240 h.p. Maybach engine, driving thru a clutch and speed change transmission a pusher screw of 5 m. diameter. The chart room is provided with large, mica bay windows and contains all the control gears, such as rudder and elevator wheels, valve and ballast lines, engine telegraphs, gas pressure and temperature indicators, as well as the usual navigating instruments. The bomb sight and the electric release gear are also located in the chart room. The four cars are connected with one another by means of a narrow gangway running in the middle of the keel, from which access to the cars is afforded by means of suitable ladders. The observation platform atop the hull can also be reached from the keel. For this purpose, a climbing tube, consisting of a wire armature covered with fabric, and containing an aluminum ladder, is fitted amidships between two gas bags. An additional lookout post is situated at the stern, aft of the rudders.

All the mobile weights of the Zeppelin, such as fuel tanks, water ballast bags and bombs, are distributed in the keel. A noteworthy feature of the *L-49* was the liberal use of trap doors thru which all mobile weights may be dropped in case of emergency, each gasoline tank, ballast bag and bomb being provided with its individual trap door. The weight per meter length of the girders forming the hull proper being 1 kg., and the length of the vessel being approximately 200 m., twenty-five longitudinals will weigh about 5 tons. Thirty-six transversals of about 80 m. circumference weigh roughly 3 tons. The total area of the outer cover is estimated at 10,000 sq.m., which, at 200 g. per sq. m. of fabric (such as used in the outer cover of early Zeppelins) puts the weight of the outer cover at 2.6 tons. A similar computation for the goldbeaters' skin of the gas bags, of which there are about 20,000 sq.m. in all, and which weighs 170 g. per sq.m., places the total weight of the gas bags at 3.4 tons. The forward and after cars weigh two tons each, the midship cars 1 ton each. From the foregoing the gross weight of the *L-49*, which had a volume of 55,000 cu.m., appears to be 22 tons. The total lift furnished by 55,000 cu.m. of hydrogen at sea level being about 60 tons, there remains 38 tons available as useful load. An airship loses 1 per cent of its lift per 100 meters ascent, and the barograph of the *L-49* showed that an altitude of 6200 m. had been attained. It is not hard to guess to what use the greater portion of the useful load is put. To reach an altitude of 6000 m. a 60-ton Zeppelin must lighten itself of 60 per cent of its weight; its total weight will then amount to only 24 tons, that is 2 tons in excess of its gross weight. The apportionment of the useful load might then be: fuel for 24 hours, 7 tons; bombs, 2 tons; crew of nineteen, 1½ tons; accessories, 1½ tons; ballast, 26 tons. Total load, 38 tons. It is obvious that a Zeppelin can attain a much higher altitude on its homeward trip than on its outward trip, as by that time they have dropped their bombs and expended a great amount of their fuel. When the ground is out of sight Zeppelins steer by radio telegraphy, that is their position is located by two widely separated land stations by the direction from which each airship's messages are received.

[Sidelights on Super-Zeppelins. *Military Historian and Economist*, Apr ,'18. 1600 words]

On the night of Oct 19, 1917, a fleet of Zeppelins made a raid on London. On Oct 20, the German Admiralty published a statement telling how the super-Zeppelin *L*-49 and three other Zeppelins came to grief. Adverse wind and dense mist were stated to have been the cause of the loss.

Full data is now available regarding the weather from the British Meteorological Office. No cyclonic disturbances were in sight, and meteorological conditions in general looked favorable.

There came, however, a shift of the wind from the anticipated direction. The latest Zeppelins are designed to fly as high as 6000 meters, and were more affected by the shift at this altitude. Zeppelins employ wireless for navigation. The flagship sends out radio signals by which it is located from the home stations, and the position then communicated. Things went well enough on the outward journey and five of the fleet reached their objective in England. Upon the return journey the wireless failed because of motor trouble. Combined with the shift of the wind this proved disastrous.

The real cause of the disaster to the Zeppelins was temperature. It was bitterly cold, 63 degrees below freezing on the Fahrenheit scale. The men had fur coats, but they were not enough. The Zeppelin must fly high to avoid gun fire, and this involves exposure to the intense cold of the upper air. The men were numbed, and both men and power were at a low point. Oxygen was provided for breathing, but this does not help the motors and lubricating oils. Some of the men had their hands frozen.

Italy

[The Type F Dirigible of the Societa' Leonardo da Vinci. *Aviation*, Aug 1, '17. 2960 words. Illustrated.]

The type F dirigible belongs to the semi-rigid class. The dirigible, by having a double envelope, is provided

DIRIGIBLES—Continued

with the following features: The gas envelope is protected against the heat and chemical action of the sun's rays; the gas envelope is relieved from the stresses and strains due to the sailing velocity; the outer envelope is made very light; the external form of the dirigible is a regular one and therefore free from additional head resistances. The outer envelope is strengthened and held in its relative place by a great number of longitudinal and circumferential bands.

The inner envelope is fitted with cross diaphragms which divide it into numerous gas proof compartments. These diaphragms intersect eight radial partitions reaching from the geometrical axis to the outer surface of the inner envelope. A strong band is formed where the longitudinal partitions meet and the rigid girder is suspended from it by a rope system. The gas envelope is made entirely of silk. Each gas compartment is fitted with a gas relief valve. These valves are used both for safety valves and as control valves. Nearly the entire lattice girder is inside the outer envelope.

The girder is built up of steel tubes stiffened with steel wires and serves to support the car, rudders, and the rigid bottom section connecting the upper platform of the car. The car is of rigid construction similar to that of the girder. The entire car is enclosed with canvas or glass. The outer envelope has a stiffening frame in its nose which supports the front portion of the envelope and keeps the nose of the dirigible in its proper shape. The steering surfaces of the dirigible are in two sets: one for dynamic compensations of the natural variations in the static equilibrium and the other for steering the ship horizontally and vertically. The former set represents a maneuvering convenience rather than a necessity. The engines are placed in the center line of the car. Both engines drive the two propellers thru a gear box arranged so that the two propellers have the same speed and both can be driven by a single engine. When either engine is stopped it can be kept hot by having hot water running thru it from the other engine. The air chamber fan, lighting dynamo, compressed air pump and intermittent switch for the route lights are driven from a special shaft. Metal propellers with adjustable reversible pitch have been adopted. The features of this ship permit: the highest altitudes to be reached; high speeds to be attained at the high altitudes; low head resistance; rapid ascending and descending speeds. The dimensions, weights and performances of the *F5* are: diameter 18 m., length 90 m., capacity 19,000 cu.m., total weight 9700 kg., total weight that can be carried at 4000 m. altitude 3500 kg., maximum altitude with military load 6500 m., power of engines 480 h.p., max. speed 70 km. hr., rising speed 1000 m. in 6 min.

—Naval Use of

[Dirigibles for the Naval Service. Crónica. *Mem. de Artillería,* Dec, '17. 800 words.]

During the month of August, French dirigibles made a total of 84 scouting trips in search of submarines.

The employment of the dirigible by the navy is justified as its special qualifications, such as wide and prolonged vision, speed, and independence of movement, partially counterbalance the bad features due to its vulnerability. The dirigible operates with vessels of heavy armament, for patrolling trade routes, and looking for mines. In this way, an enemy submarine is prevented from using its cannon.

The present French dirigibles are much larger than their British predecessors. They are twin motored and have a large radius of operation. They are not suitable for operations where they would be exposed to the fire of anti-aircraft batteries.

The hydroplane is used only for patrolling near the coast; on calm days it may venture well out to sea, but the twin motored dirigible will always be used for prolonged air cruises.

—Use of in European War

[Zeppelin Raids on ondon. From the *Kölnische Volkszeitung* of Aug 20. By Kapitan-Leutnant Freiherr Treusch von Buttlar-Brandelfels. *Army & Navy Gazette,* Oct 12, '18. 2000 words.]

Air raids on England are dependent upon weather conditions and the phases of the moon. A raid is possible only when there is no moonlight, hence from the last to the first quarter, about 12 days each month.

The most favorable weather is with a light westerly wind. The chief anxiety of an airship commander is to judge the weather conditions correctly. Weather forecasts are sent out three times each day. It is generally possible to tell in the evening whether there is any prospect of undertaking a raid.

Explicit orders covering all details govern the raids. The airships take a westerly course toward the English coast. Leaving the German Bight and approaching the coast the airship rises, reaching its greatest altitude shortly before arriving at the coast.

On one trip, no light was seen between the coast and London. This means the complete stoppage of railway traffic in a large area. London can be found under these circumstances because the Thames can be found, and it is impossible to darken completely a city like London. Further, the English themselves help by turning on a bundle of searchlight rays.

Shortly before the attack the last of the water ballast is discharged to rise still higher. The aim is to get over the city and away again as quickly as possible. The bombs are discharged at intervals of 3 to 5 seconds, with numerous incendiary bombs between.

Simultaneously with the searchlights a heavy defensive fire is let loose. The incendiary shells are the most disagreeable. The departure is difficult because of the barrage in the east. An airplane is a disagreeable opponent, because it is seldom seen while the Zeppelin is clearly visible by the searchlights. If an airplane gets above a Zeppelin, the latter is usually done for. The defense of the Zeppelin is height, because it can rise higher than an airplane and can remain at a great height longer.

A northeasterly course is steered from London, thence to the Holland coast lights and then to the German Bight.

DISCIPLINE

See

COMMAND OF TROOPS

DISEASES

See also

ASPHYXIATING GASES—PHYSIOLOGICAL EFFECTS OF
EMPYEMA
FLAT FOOT
HEART DISEASE
HOOKWORM
PNEUMONIA
SANITARY SERVICE
SHELL SHOCK
SMALLPOX
"TRENCH-FOOT"
TUBERCULOSIS
TYPHUS
VENEREAL DISEASES

DOGS

[The Development of the Army Dog. *Jour. Military Service Inst., U. S.* Nov-Dec, '17. 2000 words.]

The world is coming to recognize the fact that dogs are playing an important part in warfare, and efforts are being made in several countries to develop a type of dog which will meet the military requirements. In this country some splendid specimens of Airedales and old English sheep dogs are being crossed and it is hoped that a superior type of army dog will be produced.

The commonest service which is required of the dog is to be an auxiliary to advanced sentinels. This dog each night occupies a more or less advanced position in a shell hole, behind a rock or a tree, and, as his power of hearing is effective at a distance of 100 to 150 yards, he hears the slightest sound. When he has been properly trained he will not bark but will growl deeply, scratch the ground, prick up his ears, or in some other manner show that something unusual is taking place and warn the sentinel to be on his guard.

As to the messenger dog, his training is more delicate and requires more work. It is necessary that the dog possess certain natural qualities including a very well developed intelligence and a very powerful nose. The despatch dog may rest five or six days and then again he may have to work days and nights without cessation, resting very little and eating only when he has time. He must carry despatches rapidly between corps commanders. He also carries postal bags and artillery letters when the telephone line is cut by barrage fire or when it is impossible or dangerous to establish telephone lines.

The patrol dog searches about the ground and lets the patrol chief know whether or not any of the enemy are about. He must be able to take the offensive and also know how to be on the defensive. He must know how to throw himself on an enemy patrol or an isolated sentinel and hold him until the arrival of a friendly patrol.

The ambulance dog searches on the field of battle after the ambulance men have picked up all the visible wounded, often being able to discover wounded men in ditches, under straw or the like.

Draught dogs have been brought from Alaska and Labrador and are used for bringing up munitions, food, etc., when the snow in Alsace and in the Vosges allows only the passage of sleighs.

—Training in War and Police Duties

[The Services of Draft and War Dogs in Austria-Hungary. By Maj. Pedro Obregon y Matti. *La Guerra y su Preparacion,* Jan, '18. 20,000 words. Illustrated.]

Red Cross Dogs

Soon after the opening of hostilities in 1914 it became evident that the sanitary services would have to search for and take care of countless numbers of soldiers who were left alone in remote places on the battlefields. The Austrians decided that dogs were the most suitable animals for doing this work, and immediately started to collect and train Airedale Terriers, Dobermannpintscherr, and Rottweil dogs. The results have been splendid. So long as a dog is well trained and his keeper is equally well trained there is no difficulty whatever in locating and bringing in the wounded.

War Dogs

Following the successful use of dogs in Red Cross work it was decided to utilize their powers of scent, hearing, faithfulness and fierceness in the services of security and information. They have been found especially useful as sentinels, and as assistants to the scouts of a patrol.

Dogs were trained at Obertauern near Radstad to accompany patrols on skis thru the mountains.

Police Dogs

In the latter half of 1915 police dogs were trained for use around prison camps, supply depots, munition dumps, etc., where they acted as watchmen with a great reduction in the actual number of men who had to be used for this purpose.

Police dogs were also used in places such as Goritzia when it was under bombardment as assistants to the military police in maintaining law and order and in running down suspicious persons. They are used for a similar purpose in the occupied districts of Serbia, Albania, and Poland.

Education of Dogs for the Foregoing Duties

Dogs were conscripted for the duration of the war and in some cases for a stated number of years. In order to satisfy the public as to what their dogs are doing demonstrations are given at stated intervals at the larger cities in Austria-Hungary in which trained dogs with their keepers performed, illustrating the methods of using dogs.

Oganization of the Schools for Keepers of War and Red Cross Dogs

There are two places of instruction for these men, one at Cerstorf near Vienna and the other at Schafberg.

(The author goes into the details of construction of the kennels, etc., of the establishments at both the above places, giving plans and dimensions.)

DOGS—Continued

Permanent Personnel of the Schools

A first lieutenant is in commend at each school. He has under him two second lieutenants, two lieutenants of the Quartermaster Corps, two sergeant instructors, one sergeant who procures dog food under supervision of a veterinary, two cooks, two butchers, two assistant cooks, the necessary office force—mechanics, etc.

The technical instruction is under three men who have had years of experience in raising and training dogs. These technical instructors have about 16 assistants who are chosen from the ranks according to their experience with canines.

Provision and Education of the Dogs

Only four breeds are used, Airedale Terrier, German Shepherd, Rottweil and Dobermann. The animals are provided by the public. Dogs are accepted for service after a quarantine of 10 days, providing they show no signs of contagious diseases or of mean traits during that period. They are signed over to the government. In case the dog is not given freely the government will pay up to 150 or 200 crowns for a good dog.

The dog is taught two positions—those of "attention" and "rest"—corresponding to similar positions of their keepers. In the first position the dog must sit on his hind legs—in the second he lies down. At first these positions are practised by giving oral commands to each dog, later it is done in formation, each dog at the knees of his keeper assuming the position at a signal. The exercises are then given at a walk, the dogs being on a leash, and later the leash is removed. The dog remains always on the left of his keeper. Each keeper must be provided with a light switch with which to enforce obedience from his dog. One exercise, which is the most difficult to teach the dogs, is when they are made to remain lying down while the keeper goes away. They are taught to remain thus for several hours at a time. Later they are taught to remain "down" while the keeper fires his gun. The exercises are then given by groups of up to 20 dogs.

Later the dogs are put thru special courses as follows: (a) Red Cross dogs—the locating of hidden or abandoned wounded; (b) Sentinel dogs to accompany patrols, advance guards, sentinels and listening posts; (c) Police dogs for occupied territory; (d) Police watch dogs, to prevent the escape of prisoners, to trail and capture escaped prisoners, to guard important military buildings; (e) Rat dogs, to exterminate rats and mice in the trenches; (f) Messenger dogs.

Red Cross Dogs

The dog is taught to bring to his keeper some object from the person, or immediate vicinity of the wounded man he locates. Lately this system has proven inconvenient for many reasons, and the dog is taught to grasp a small leather strap in his mouth and run with it in his mouth to his keeper. This leather strap is hung to the dog's collar. He only takes it in his mouth when he locates a wounded man.

Sentinel Dogs

These dogs are taught to work without barking and to depend more on the sense of hearing for locating anything. They are taught to advance against and attack and hold men.

Police dogs are trained in following scents and trails.

Ratdogs are chosen from the fox terrier and bull terrier breeds only.

Messenger dogs are taught to keep away from everybody except their two keepers, and to allow no one but their keepers to touch their collar. They are taught to avoid obstacles and to disregard shell explosions. In order to send a messenger dog out with a message he must be taken over the route once. After that he will travel back and forth over that exact route.

(The author discusses the selection of keepers and the necessity for having men with an aptitude for the work. He then gives a schedule of the instruction as given at the Austrian training school. The construction of the barracks, kennels, etc., is described and supplemented with dimensioned drawings.)

Draft Dogs

These dogs are picked from the St. Bernard and Leomberz breeds. They are chosen with respect to breeding, scent, hearing and instinct—size is not a consideration.

Dogs were first used in the Tyrol to haul supplies and construction material. The constantly increasing shortage of horses has caused the adoption of dog trains for every sort of transportation—supplies, ammunition, light infantry guns, wounded, etc., and in the smaller garrisons dog teams do all of the hauling. Small 4-wheel carts are used, and in winter, runners are placed under the wheels or else they are attached directly to the wagon gear.

(The article concludes with 17 photographs of dog-teams at work in the field.)

[The Dog in War. Abeilhé. *Memorial de Caballería*, May, '18. 1700 words.]

Dogs were first universally used by the Sanitary Services, tho the Germans paid more attention to the development along purely military lines. Being a draft animal in northern Europe, the dog has been for years a factor in the Belgian Army, both in supply and machine gun service.

Dogs have developed into sentinels, couriers, and patrol, supply, and sanitary animals.

Germany, having gained control of northern Europe, has cornered and used all the former draft dogs, forcing the Allies to use what they can get. The British run to the Scotch Mastiff (used in Transvaal), some prefer wolfhounds (Manchurian experiments), the Germans use their mastiff to some extent, while the French have had to take the leavings.

These dogs are sent to a Canine Training Depot in rear. The first instruction establishes the dog's confidence in the instructor and in the uniform of the Army. Later, men dressed in hostile uniform stalk the dog. He is encouraged to bark. This is the sentinel stage. The courier is taken further, he is made used to explosives. Hachet-Souplet's system is used to familiarize him with persons and their belongings. The ground is marked out with points of departure and arrival, using small pennants of colors of low visibility,

at progressive distances. The dog is made to sit down at the start, is told to go, and is fed at the finish. Scent aids him to find the bait; the color of the pennant teaches him to use his vision.

(The author evidently means that in service, dog is shown a color—he goes to a spot where he knows there is a similar color.)

Draft training is necessarily less involved. Pairs of draft dogs have given six to eight hours of work without showing fatigue.

DUGOUTS

See

Entrenchments—Bomb-proofs

DYNAMITE

See also

Explosives

EDUCATION, Military

See also

Aeronautics—Instruction and training
Bridges, Military—Bridge troops—Instruction and training
Cavalry—Instruction and training
Engineers—Instruction and training
Field artillery—Heavy—Instruction and training
Field artillery—Instruction and training
Infantry—Fire—Instruction and training
Infantry—Instruction and training
Libraries, Military
Officers—Instruction and training of
Rumania—Army—Schools and training
Sanitary service—Instruction and training
Schools, Military
Wounded—Instruction and training of

[The Officer as an Educator of Troops. J. M. Niera. *Memorial del Estado Mayor de Colombia,* Feb, '18. 1500 words.]

The officer as an educator of the soldiers under his care should have following qualities: Patience, self-abnegation, will power, kindness towards subalterns, and love for the soldier's profession.

The officer prepares recruits from civil life for war. He has under him men from every walk of life, who must be given the necessary military training to make them efficient fighters, and at the same time, they must be taught the highest moral principles, and made to live up to them.

Officers should be obeyed not only by force of discipline, but because they are held in respect by their men. In order to secure this state of affairs, officers will have to set an example of honor, respect to superiors, fulfillment of duty, neatness, correctness of speech, bravery, and executive ability.

In the formation of character of the men under him, the officer has practically the same influence as a primary teacher has over his pupils.

[Military and Scientific Teaching. By Count of Casa Canterac. *Memorial de Artillería,* Feb, '18. 16,000 words.]

The author believes the educational systems of nations as a whole are faulty. He lays this to the examination system, which he believes is an injustice to the pupils. All his teaching is a preparation for final examinations, and his teachers will only educate the memory at the expense of a general mental development.

Among the many difficulties of educating the young officers arises the age question. The cadet entering the military academies should be of an age so that upon graduation and for the term of his sub-lieutenancy he can be classed as a young officer. At the same time the young cadets should have certain industrial and scientific knowledge before entering a military academy. The author believes proper entrance qualifications to military academies can be obtained by including in the entrance examinations higher algebra, trigonometry and descriptive geometry.

After discussing entrance qualifications the author takes up the problems which present themselves in developing a teaching organization in a military academy.

These problems are discussed under the following general headings:

1. The entrance qualification system, and system of early training.
2. Development of military and scientific teaching within the academy should be such as to develop the intellect and not train the memory alone.
3. Selection of teaching staff—the duties of instructors and the privileges they should be granted.
4. Selection of text-books. The author insists upon text-books of general merit which require study before their contents can be mastered.
5. Methods of amplifying the knowledge acquired after the cadet becomes an officer, by laying down courses in reading, study, and practical work.

[A Branch of the Preliminary Education of the Officer. *Kungl. Krigsvetenskaps-Akademiens Tidskrift,* Feb, '18. 1200 words.]

(An article giving valuable points on the theoretical as well as the practical sides of the preliminary education of the officer.)

[Instruction and Teachers. By Jose Marva. *Mem. de Ingenieros,* July, '18. 700 words.]

(A discussion of the value of good school teachers as compared with the value of books and courses of instruction.

Not believed to be of general interest.)

—In Schools and Colleges

[Importance of Military Instruction in Establishments of Learning. By J. M. Neira. *Memorial del Estado Mayor de Colombia,* Nov, '17. 2000 words. Photographs.]

Compulsory service was instituted in Colombia in 1896, and the laws pertaining thereto were altered slightly in 1909, but the good results expected have not been realized.

A similar law was passed in Chile in 1900 and in 1917 Chile had a first reserve of 145,500 men; 1914 her reserves aggregated 287,000 men.

EDUCATION, Military—Continued

The present strength of the Colombian reserve force is not known because our organization has been so lacking and our irresponsibility so great, that records of men who have received military instruction in the various units have not been kept.

In view of these, and many other irregularities in our form of recruiting soldiers, every good citizen looks for some means of putting the country on a military basis, which will harmonize with the actual necessities, and with the idiosyncracies of a people who do not know their first patriotic duties.

The best way of properly organizing a military establishment is by having military instruction in places of learning.

At present the public instruction of the youth of Colombia is carried on by 7169 graduate professors. If years ago military instruction had been instituted in the primary schools these professors would now be reserve officers who would be able to give military instruction to the 300,541 pupils they actually have. If the instruction were properly carried on, beginning with physical drills, and in general following the German system, it would result in a great gain for the nation.

Of the 5200 buildings used as schoolhouses, not 5 per cent afford the proper hygienic conditions. They are for the most part small run-down buildings, improperly furnished and poorly kept. No gymnasium facilities are available. The result is that the boys are not physically developed, and are surrounded by a thoroly depressing atmosphere.

Gymnasium training is considered important in all the larger countries. Germany, in the year 1910, had 8600 gymnastic societies with a total membership of 900,000.

In Japan gymnastic training and military instruction are obligatory in all the public and private schools. At present there are 50,000 schools in Japan in which 160,000 professors teach 7,000,000 pupils. There are 300 secondary schools whose students receive military instruction from the universities of Tokyo and Kioto.

Gymnastic training is compulsory in all Swedish schools.

Military instruction is also given in the following subjects in the order named:

1. General knowledge of army organization, grades and insignia of officers.
2. Sending and receiving orders.
3. Security on the march and in camp.
4. Communication.
5. Scouting and reconnaissance.
6. Instruction with arms—Manual, marching, turnings, positions of skirmisher firing, pointing and aiming drills.
7. Open order; formation and movement of the skirmish line; taking advantage of cover; occupation of positions; kinds of fire.
8. Nomenclature and manipulation of the piece; care of the rifle; ammunition, and a complete target course.

In Switzerland gymnastic instruction is obligatory for all boys between the ages of 10 and 15 years who are in school.

(The author mentions the system of the United States.)

The Argentine government passed a law in 1915 providing for compulsory military training in all the colleges and institutes in the country. The instruction is divided into two periods. The first course is from age of matriculation until 15 years, the second course for students between 15 and 20 years.

Military instruction up to and including the school of the company is compulsory for all pupils 16 years and older who attend the high schools and secondary schools operated by the Brazilian government.

The Peruvian government passed a law in 1916 creating compulsory military courses in the normal schools, with the object of making these graduates reserve officers. These courses last 3 years and are prepared by the general staff. Engineer and artillery officers are chosen from the graduates of engineer schools who take the military course.

Peru also provides for gymnastic training of its youth. The law is similar to that in Switzerland.

The Venezuelan government is now preparing a military instruction law which will apply to all schools.

In Chile, the little South American Germany, there are no laws providing for the military instruction of school boys. Captain Areneda, a distinguished Peruvian officer, calls attention to this deficiency in the school laws, and lays down a very comprehensive method of imbuing the youth of both sexes with patriotism, and giving the boys a basic military training. He advocates a nursing course for girls in order to prepare them for Red Cross work.

Colombia, the most intellectual of the South American countries (it is only 24 per cent illiterate) remains indifferent to its military backwardness.

The governor of the Department of Tolíma has the proper idea. He has ordered compulsory military service for all normal school pupils in the Department. The instruction is given by officers of the Garrison at Ibaguey.

—Methods and Equipment

[Instruction in the Armies. Furnished by the French Mission of Information. *Infantry Jour.*, Jan, '18. 2200 words.]

The present war is developing to the highest degree the power of matériel and of all sorts of machines both for the distant combat of artillery and the close action of infantry. It is necessary constantly to improve and change the means and methods of combat. The advantage will remain with the side which best employs the principle of economy of force and which knows how to make the engines of war give their best results.

The foundation of all military instruction is the school. In this war it is necessary: (1) To organize schools for specialists, where men can learn the employment and use of the tools they are required to employ; (2) To establish schools for command, where officers of all grades will be instructed in the essential

principles of modern war, in the method of teaching employed in the schools of specialists, and in the proper employment of different military means and engines. By these schools the complete harmony between the different arms, and also between the commander and his troops can be secured.

This war has made necessary the hasty instruction of many officers, and schools fully supplied with means of instruction and information alone can accomplish this task. This instruction permits the training of specialists and their close co-operation in battle.

The organization of military instruction must provide for: (1) Instruction in the essential principles of war, and the combination in combat of the different arms and engines employed; (2) Technical and tactical instruction of specialists.

The organization of courses of instruction is based upon the following principles: (1) There can be no well-instructed army without good instructors; (2) It is necessary to train the instructors before training the troops; (3) In order to prepare the instructors, schools of all arms must be established; (4) In order to organize schools of instructors the officers most qualified to teach must be assembled.

A condition of permanence and of continuity is necessary in such schools of instruction if the best possible results are to be obtained.

In France the system adopted in the armies at the front is that of centralizing the instruction in each army. This instruction embraces: (1) Schools of the line—(a) Course for captains which prepares for the command of the battalion, (b) Special course for commanders of division depots, (c) Course for company commanders, (d) Course for non-commissioned officers, (e) Practical course in artillery fire, and (f) Practical course in engineering; (2) Schools of specialists—(a) School for grenadiers, (b) Machine-gun schools, (c) Automatic rifle school, (d) School for the 37 mm. gun, and (e) School of liaison and signalling. These schools are generally in a zone about two or three days' march from the front.

In addition to these schools, practical instruction is given in the division depots to recruits who have just joined combatant organizations. Behind the front are instruction battalions formed from recruits of the youngest classes, and in the interior of the country are vast camps where schools of specialists carry on their training.

These are the general lines of the French and British systems. Modern armies require instructed troops and specialists. The instructions of the troops gives them indispensable information on the procedure in battle, and assists the officers in their employment so as to obtain from them their best efforts. The instruction of specialists employs such methods as will give a man full confidence in his arm and weapon, a confidence based upon results obtained by employing it under the conditions of battle.

[The Spirit of Training. *Infantry Jour.*, Jan, '18. 1500 words.]

A large percentage of the able-bodied men of the United States are now under the control of our military authorities, and the responsibility rests on the Army to make those men as fit and efficient as is possible. All the countries in this war have had to train new armies; the United States, like England, started with an organization made for peace times, and which was not especially adaptable to expansion.

Efficiency, in the shortest space of time, must be obtained. The army must be organized on some settled principle, a General Staff must be created, new officers and non-commissioned officers must be trained, and experienced officers must be kept abreast of the rapidly changing conditions of modern war.

This efficiency can be secured only by developing an *esprit de corps* along with the technical training. New armies build up traditions from the day the unit is formed. The spirit of training should be a spirit of self-reliance, loyalty, and kindness, all based on a strong sense of discipline and community of interest. In training, you must begin with discipline, to obtain the full benefit of your efforts. History has shown many instances where discipline, and discipline only, has saved the day.

An officer should be so in sympathy with his men that they will regard him as a companion and friend. The soldier can be brought to the highest efficiency by inducing him to believe that he belongs to a unit that is superior to others around him.

The fundamental principles of successful training are uniformity of training and systematic instruction and the first necessity is the rapid development of instructors.

We are in a fairly happy position, with comparatively unlimited resources, in direct touch with our overseas forces, and with the experiences of foreign armies at our disposal.

EMPYEMA

[Empyema. By Capt. Eugene W. Rockey, M.C., U. S. Army. *The Military Surgeon*, Oct, '18. 3000 words. 18 cuts, 1 table.]

As the result of experiments at Camp Lewis, Washington, all cases of empyema were divided into two classes; those caused by pneumococcus common in civil life, and those caused by a hemolytic streptococcus. It is to the treatment of the latter that this article is primarily devoted, but as regards the former, the method of rib resection and simple drainage gave the best results.

The variations with which empyema occur make diagnosis difficult. In those cases following measles there were 40 per cent mortalities, and post mortems disclosed purulent pericarditis, walled-off pockets of pus between the lobes, and substernal pockets. In some cases due to the pocketing tendency of pus, two incisions were necessary to reach separated pockets. The pus thus removed did not give the conventional appearance of pus, but rather of a cloudy fluid, which on analysis showed pus cells and streptococci. This fluid is now classed as pus, and all cases in which it appears diagnosed as empyema.

In the treatment of empyema caused by hemolytic streptococcus the average time from the first pulmonary symptoms to the time of operation was 14 days. This

EMPYEMA—Continued

was primarily due to the fact that the patient was kept waiting for a thick pus to form. In taking test specimens with the diagnostic needle, frequently only a cloudy fluid was withdrawn, whereas if operation followed immediately, a comparatively thick pus was found.

While waiting for this thin pus to thicken, many methods were tried and abandoned: Aspirating not only failed as a treatment, but was followed by metastatic abscesses and facial erysipelas. Rib resection with simple tube drainage, which proved satisfactory with pneumococcus infection, failed, and mortalities under this method were 25 per cent. Of those who recovered, there are several cases of marked lung collapse, and large pneumothorax cavities. An effort is now being made to reduce the size of these cavities by simple negative pressure. The finally adopted method is *simple thoracotomy with continuous negative pressure.*

This treatment is conducted as follows: *Equipment*—one ⅝ inch stiff, walled rubber tube, 8 inches long. Three inches from one end is cemented a rubber dam flange 5 inches square. Perforations are then made in the long end of the tube, commencing 2 inches from the flange, and the holes made spirally to prevent a weakening of the tube which might cause collapse, yet so arranged as to get the maximum number of openings. *Method*—Under ¼ per cent novocaine, local anesthetic, a diagnostic needle attached to a 30 c.c. glass syringe is introduced thro the chest wall at the site selected for drainage. This location is usually in the post-axillary line, about the sixth interspace or posteriorly below and inside the angle of the scapula. If purulent fluid is obtained, the syringe is disconnected, leaving the needle sticking thro the wall of the chest into the pus cavity. A 1½ inch incision is now made alongside the needle. With a sharp scalpel make a ¼-inch incision thru the intercostal fascia, taking care not to cut too deep and wound the intercostal vessels which lie at the lower border of the rib above. The needle is grasped in a hemostat to prevent its loss in the wound. The patient is now given nitrous oxide anesthesia, and then a strong curved hemostat is boldly pushed thro the interspace along the needle. The needle is now withdrawn and the hemostat forcibly opened and withdrawn while open, making an orifice sufficiently large for the insertion of the previously prepared tube, which is introduced and inserted to such a level that the rubber flange will come to the outside of the chest wall. Care should be made to see that the tube is so directed that it will lie close to the chest wall within the cavity. The gas anesthesia is now discontinued (the usual time of gas anesthesia being 2 minutes). As soon as the pus flows freely thro the tube, the outer end is closed with a hemostat to prevent air from entering the chest cavity.

The skin and muscles are now approximated with two interrupted silkworm gut sutures, one on either side of the tube. After the sutures are tied, they are passed about the tube, holding it in place. The rubber dam flange is laid smoothly on the chest, and the dressing, consisting of a single gauze and cotton pad with a slit in its center, is placed over the flange with the tube projecting, and fastened with adhesive tape.

The patient is now turned towards his affected side and the end of the tube draining into a bucket. He is instructed to take a deep breath and then blow hard. During inspiration the hemostat is kept closed, and opened during the forced expiration. Thus by using the hemostat as a valve the chest cavity is emptied of pus without the entrance of air. When the cavity is sufficiently emptied, the hemostat is clamped on the tube and patient taken to his ward and put to bed.

Next comes the application of the treatment by negative pressure. *Equipment*—A water pump is attached to an ordinary faucet. This pump consists of an attachment with "T" offset which leads to the apparatus which is attached to the patient. The flow of water thro the faucet and attachment causes suction in the offset, which is maintained thruout the apparatus and is what is termed as "negative pressure." The rest of the equipment includes a water gauge and a bubble gauge, and the necessary pipes leading to the beds in the ward, all supplied with stop-cocks. *Method*—From the stop-cock is run a piece of rubber hose to the shorter glass tube of a drainage bottle equipped with two glass tubes thru a perforated stopper. From the longer tube is run a rubber hose which fits on the tube which is inserted in the pleural cavity. By now removing the hemostat a constant suction, or negative pressure is maintained in the drainage bottle and in the pleural cavity. A bi-chloride of mercury tablet dissolved in one ounce of water is placed in the drainage bottle every time it is emptied.

Inasmuch as the patient cannot stand the normal pressure immediately after operation, and as a negative pressure of 24 inches seems too great, not only keeping the cavity free from pus, but also inducing blood into the drainage, it became necessary to insert a pressure regulator, or what is termed a pressure reducer. In this way a pressure of 8 inches can be used immediately following an operation. The normal negative pressure which keeps the cavity clean has been established with this style of equipment to be 18 inches.

The pressure reducer consists of an apparatus shunted in between the bedcock and the drainage bottle. It consists of a large glass tube with perforated cork thru which two small tubes are passed. One of these small tubes just passes thru the cork, the other extends almost to the bottom of the tube. The short tube connects with the bedcock, the long tube with the drainage bottle. Enough water is placed in the large tube so that when the pressure is exerted there will be a difference of 10 inches in level between the small and large tubes. This is determined by experiment.

The amount of the drainage depends on the success of the original operation, but the normal results so far obtained are from 500 to 1000 c.c. during the first 12 hours.

The X-ray has proved a valuable auxiliary in such cases to check up on the progress of the treatment. By this means one of the greatest common faults is practically eliminated—that of removing the tubes too soon. The average time between operation and the first dressing is now 3 days.

From the results of these experiments it has been determined that pneumococcus empyema is successfully treated by rib resection and simple drainage, and that streptococcus empyema is successfully treated by thoracotomy and constant negative pressure. To attest the virtues of the latter, the following should be considered: no mortality, whereas at first it ran as high as 40 per cent; smooth post-operative convalescence, absence of pneumothorax, and economy of labor and materials.

Mention is also made of the Carrel-Dakin method of treating streptococcus empyema, which method has met with marked success at the Rockefeller Institute.

ENCAMPMENTS

See also

MOBILIZATION—CONCENTRATION CAMPS

ENFIELD RIFLE

[Uncle Sam's New Infantry Rifle. By Edward C. Crossman. *Scientific American*, Dec 1, '17. 2100 words. Illustrated.]

For the second time in our history, American troops will go into action armed with a mixture of Springfield and Enfield rifles. The official title of this arm is "303 Pattern '17." The British-designed rifle being made here for our draft army has little in common with the old British Lee-Enfield.

The latter has been retained by the British because the war caught them in the process of changing to the new Enfield-M 1914, of .276 caliber, but not enough changed, especially with reference to cartridge production, to make possible its entire adoption to the exclusion of the .303 Lee. In this situation, the undesirability of using two cartridges in the field compelled the British to throw over the .276 bullet, and to set their arsenals and private makers to work grinding out the old Lee-Enfield. But the American factories accepting the British contracts were given the specifications of the new rifle with which the British army would have been armed in another year or so had it not been for the war; only, instead of making it for the new but temporarily abandoned .276 cartridge, the specifications were of course for the old .303.

Accordingly, when we got into the war, our private plants had available some $15,000,000 worth of machinery, sufficient to produce ten to fifteen thousand of these rifles per day. One of our arsenals, Rock Island, had been closed for some years, so far as the manufacture of small arms was concerned; the other, Springfield, is inadequate to meet the sudden demand for millions of rifles. So the sensible thing was to adopt, for our new army, the British rifle, pattern of 1914, which we are equipped to produce—but chambered for our 1906 cartridges, which we are also equipped to produce; and the manufacture of this arm was actually started in July of this year at the great plants at Ilion, Bridgeport, Eddystone and New Haven.

The British rifle, pattern of 1914, commonly but incorrectly styled "Enfield," is essentially the Spanish or Boer Mauser, as we know that type. It cocks on the closing motion in the same way; in the same way it prevents trigger motion when the bolt is not entirely closed; it has the same locking lug arrangement, and practically the same form of bolt stop and ejector box; the magazine is the same, the floor plate lock practically the same. The changes necessary to adapt this .303 British rifle to our cartridge were not many. The bore was changed from .303 to .30, the magazine follower adapted to a rimless shell, the bolt head slightly altered, and the clip slot reshaped for our clip.

The feature that immediately takes the eye is the position of the rear sight of the new rifle. It perches back on the receiver bridge, and is merely a very generous peep. Unlike the sight on our new Springfield, there is but one thing thru which to aim—the large peep, which cannot be overlooked by any man with normal eyesight. This sight does not stand vertically, but leans slightly away from the shooter, the purpose presumably being to aid in reading the graduations. When the sight leaf is laid flat on the bridge, in its protecting wings, another peep stands up in the line of sight; this is the battle sight.

Where the peep sight of the latest Springfield is roughly ten inches from the eye of the prone soldier, and but .05 inch in diameter, the peep sight of the new rifle is only four or five inches away, while the aperture is roughly .10 inch. The leaf is graduated to 1600 yards. The slide—the movable portion carrying the peep—is self-locking, a release lever dropping into the notches cut, one for each 50 or 100 yards, in the side of the leaf. Because there is no intermediate stop between these marks, the target shooter would emit loud wails of anguish if asked to use the rifle. Also the lack of wind gage—this is purely a fighting man's rifle—would make the favorite American sport of wind-doping at long range as impossible as a trepanning operation conducted with sledge hammer and cold chisel.

I find by trial that the battle sight is ranged for 350 to 400 yards. A rapid fire string of ten shots from the kneel scored nine hits on the silhouette and one close up on the four ring. Here I held the front sight just touching the bottom of the figure; so judging by this, the rifle is sighted far more satisfactorily for battle or fixed range than is the new Springfield, which in order to hit a prone man at 200 yards has to be held two feet below him.

The front sight is too narrow, worse than that of the Springfield, because the same width—.05 inch—and farther from the eye.

Instead of using the hood or cover over the front sight, as on the new Springfield, the new rifle has two high wing guards, rising on either side. So the front sight is less protected than that of the Springfield, less easily caught when shooting in a hurry, less easily seen because of the flood of top light pouring down on it. The wings give one the uncomfortable feeling of having to choose between three front sights.

The bolt handle has a peculiar ramshorn twist, curving down and then back toward the butt, to shorten the reach when the rifle is being reloaded at the shoulder. The curve brings the handle just forward of the knuckle of the trigger finger. Gripping the rifle and putting the finger thru the trigger guard

ENFIELD RIFLE—Continued

tended almost invariably to raise the bolt handle so that the rifle could be neither fired nor made "safe." Also in firing over a parapet the bolt handle has a pleasant tendency to jam into the knuckle from the recoil.

The safety is not a part of the bolt sleeve as in familiar models, but is pivoted in the right side of the receiver, abaft the bolt handle, and works parallel with the barrel. Pulling it back operates two plungers entering recesses cut, the one in the bolt handle, the other in the firing pin head. Because the former recess must be exactly in line with the plunger, the slightest upward motion of the bolt handle, as before remarked, prevents the soldier from putting on the safety.

The magazine is essentially that of the Springfield and Mauser, but holds six cartridges instead of five, due doubtless to the more compact rimless 1906 American pills.

The British rifling is adhered to, left hand twist with five equal grooves and lands. The Springfield has four lands with right hand twist. Apparently the new weapon likes our bullets, for 75 shots, ten of them rapid fire, without bullet lubricant, failed to deposit even .0001 inch of metal fouling on the lands, which is not the case under the same conditions with the Springfield.

The stock has a sort of pistol grip, and gives the same appearance as the Lee. It is extremely uncomfortable in any position, particularly the prone. The butt plate is badly shaped, and bruises the shoulder. The stock pounds the jaw.

The rifle has 26-inch barrel instead of 24, the length of the Springfield, and is 46 inches over all against 43¼ for the Springfield. Also it weighs ten pounds or more complete, about one pound more than the average Springfield. Much of this weight seems to lie in the barrel at the breech end, where there is a lot of unnecessary hardware. With a long and hungry bayonet on the muzzle, making 11 pounds in all, the handling of the arm takes a pretty husky citizen; it would be better for the sort of fighting now in style if nearer nine or nine-and-a-half pounds with bayonet fixed.

There is no magazine cut-off as on the Springfield—which is correct; there is no need for one with a clip loading rifle. The magazine follower, however, as on the Springfield, holds the bolt open when the magazine is empty. Accordingly drill with the empty rifle in the firing motions is made possible only by the issuing, with each rifle sent to the camps for drill purposes, of a "depression follower" which, held under the edges of the bolt wall, allows the bolt to go forward without obstruction and permits use of the rifle as a single loader. The purpose of holding open the bolt when the magazine is empty is to prevent the excited soldier from continuing indefinitely the motions of firing on an empty chamber, as experience proved that rattled troopers used to do with the Krag in action.

The bolt and receiver are made of nickel steel and are hardened and tempered. This does away with the cracking lugs found on the new Springfield now and then, due either to faulty processing during case hardening or to steel with too high a carbon content. Whether the lugs will stand the wear and upset thrust of the powerful cartridge, remains to be seen.

In conclusion, the new rifle is a beautifully finished arm, equal to any sporting rifle. On the whole, it is superior to the Springfield. Outside of the feature of the rear sight, the Springfield is preferable because of better position of bolt handle, lighter weight, better safety and better stock. Of the two, however, both handled by men of the same length of training, the 1917 weapon would win hands down because of that splendid, fool-proof, easily caught rear sight, as compared to the complicated, unsatisfactory Springfield sight. Susceptible as it is of further great improvement, as a man-killing weapon Uncle Sam's new shooting iron stands without a superior in the infantry rifles of the world's armies.

ENGINES

See also
Motors

ENGINEERS

[Proposed National Congress of Engineering and of Army and Navy Engineers. By La Redaccion. *Mem. de Ingenieros,* July, '18. 1100 words.]

A discussion of the probable value to Spain of the proposed Congress of Engineering and of Military and Navy Engineers, scheduled for the spring of 1919: its value in time of peace and as preparation for war in case of need. General Joffre quoted: "To-day, to be considered prepared for war it is indispensable that all resources be aligned ahead of time having in view a single object, victory. It is necessary that the entire organization be complete, for when hostilities are once begun it is certain that whatever is improvised is inefficent and the least hesitation may lead to disaster."

United States

[The New Engineer Units of the American Army. *Mem. de Ingenieros,* Mar, '18. 900 words.]

Benefitting by the experience of the European armies, the United States has greatly increased the proportion of engineer troops in its new army. A recent order gives the following units for each American field army, in addition to the divisional engineer troops:

1 regiment, gas and flame;
1 regiment, mining;
1 regiment, water supply;
1 regiment, general construction;
1 regiment, engineer supplies: 1 battalion transport, 1 battalion skilled labor, 1 service battalion to aid in this work;
1 battalion, mapping and printing, extra officers to be assigned as needed;
4 battalions transport service, 6 service battalions to aid in this work, 6 truck trains of 31 trucks each, 5 wagon trains of 61 wagons each.

Assigned to the line of communications and constituting an independent group, each field army is to have the following engineer troops:

1 regiment, general construction, 6 service battalions to aid in this work;

1 regiment, engineer supplies, 3 service battalions to aid in this work;

10 battalions, forestry, 9 service battalions to aid in this work;

1 regiment, quarrying, 3 service battalions to aid in this work;

Railway service as follows: Narrow gauge—5 battalions, construction, 3 service battalions to aid in this work; 4 battalions, operation, 3 service battalions; Standard gauge—5 regiments, railway, 8 service battalions for construction; 6 battalions, railway, 3 service battalions for operation; 1 regiment, machine shops.

—Engineer Troops

[Organization of Sapper Engineer Troops. By M. Fenech. *Mem. de Ingenieros,* July, '18. 1400 words.]

The work of engineer officers in an ordinary campaign is becoming every day more complicated and difficult, on account of the increased size of modern armies, and the continual development of means of destruction as well as the development of the arts of engineering. The individuals who most appreciate this condition are the engineer officers on duty with sapper regiments. To appreciate the variety of work which these officers must be able to handle, one has only to look at a company wagon train and see the great variety of implements and tools carried therein and to realize that the section (the working unit of the company) must contain men capable of using each, the demolition tools, the mining and carpenter tools, as well as the masonry and stone cutting implements, telegraphy, blacksmith outfits, etc.

It is believed essential to develop a number of well trained workmen within each company, especially in mining and carpenter work, and it is also believed that the best way to do this would be to give increased pay to the men who can qualify on this work, both practical and theoretical examinations to be given, the increased pay to be apportioned out in quantity according to the length of service of the qualified men.

—Engineering Construction

See also

LAUNDRIES, MILITARY

—Engineering Construction—Computations

[The Holding Power of Nails. By Lt. J. M. H. Goodwin, R.E. *Royal Engineers Jour.,* Dec, '17. 1000 words. 7 figures.]

(A mathematical discussion on the subject of the holding power of nails as used in wooden structures, a point on which texts on Military Engineering are incomplete. It is found that the direct pull a nail will withstand is the product of the length of nail imbedded, the area per inch of length, the coefficient of friction between the nail and the particular wood used, and the ultimate shearing stress of that wood. The tranverse pull a nail is capable of resisting is $\sqrt{3}$ times the direct pull it can sustain.)

—Field Operations

See also

BRIDGES, MILITARY

MINES, LAND

INFANTRY—SPECIAL DUTIES

SAPPING AND MINING

WATER SUPPLY

[Liaison of Divisional Engineers with the Other Troops. By Maj. Rousseau, French Army. *Professional Memoirs,* Jan-Feb, '18. 4000 words.]

(This article is based upon three years' experience with the French engineers, but in the distribution of troops for their various duties the numbers have been modified to suit the American organization of 6 engineer companies to the division.)

The term "liaison" has not quite the same meaning for engineers as for the other arms. The infantry and artillery will make their maximum effort at the climax of the battle, while the chief endeavor of the engineers will be exerted less during the battle than before, in preparing the attack, and after the assault, in organizing the conquered ground.

At the beginning of the war few of the French leaders understood the proper use of their engineers. In consequence, they were wasted and melted rapidly away just as they were becoming more and more important. They were promptly recruited by selecting from the other branches men and officers susceptible of becoming engineers, and the number of engineer troops was doubled. Strict orders were also given to prevent their misuse.

Now detachments of a maximum strength of a section are included in the attacking waves, solely to perform tasks requiring special engineering skill. In the first wave, such a task is the rapid destruction of obstacles; in the following, the destruction of blockhouses or dugouts; in general, those things requiring the use of explosives and special apparatus. The main body of engineers remains grouped in units no smaller than a company, following the general movement, but well back from the first wave. One part of this main body secures and repairs communication. The remainder is kept in reserve to be brought forward to assist in organizing the conquered ground if the battle is retarded.

During the battle the chief engineer of the division is in the command post of the division commander. The small detachments working with the infantry are usually cut off from communication with the chief engineer until the end of the engagement. The other engineer troops may, however, be kept in touch with by means of the telephones in the command post and thru the division engineer's staff. Reports from commanders of engineer battalions and smaller units will often be in the form of sections of the general maps on which are indicated the various matters concerning which up-to-the-minute information is essential, such as the actual practicability of all the regular avenues of the battlefield, new lines of communication opened up, etc. The plans for the organization of the conquered ground have all been made before the movement started, so that instructions in this regard are unnecessary, unless the progress of the battle has been such as to render desirable a considerable change in the scheme of organization.

ENGINES—Continued

Between battles the engineers are employed on works in rear, on communications, assisting the regiments in the front line, the artillery and the sanitary service, or in training or resting. During this time the liaison between different units and the chief engineer presents no difficulties. That officer must, however, keep thoroly posted at all times as to the exact status of all engineer work in the division's sector and the amount and condition of all engineer supplies, making ample provision for the necessary replenishment of the engineer depôts by keeping supplies moving up from the rear.

—Instruction and Training

[Distribution of Time in the Instruction of Sappers and Pontoniers. By Capt. Montes. *Revista Militar* (Argentina), Sept, '17. 4800 words.]

This article is based upon the necessity for undertaking in intensive form the thoro preparations and training of officers and sub-officers of engineers for their technical duties in war.

The following distribution of time is recommended, assuming that a period of six months is allowed for instruction and that time will be available later to put into practical effect the results of the instruction.

1st Period (Duration 4 months).

Instruction of recruits, school of the soldier and squad, rowing, preliminary instruction in sapping and mining, tackles and cordage, marching, firing, etc.

Instruction in field service and combat tactics.

Target practice.

Marching, up to 20 kilometers in one day.

Bivouacs.

Special Instruction.—Use of instruments and tools.

2d Period (The remainder of the period).

Regulation bridges—4 weeks.

Fortification and explosives—2 weeks.

Ponton bridges and ferries—2 weeks.

Applicatory problems—4 weeks.

During the last 4 weeks, which should be a still longer period if the conscripts have more time in active service, strategic works of permanent advantage could be undertaken.

With this end in view the engineer companies of several army corps, and if possible some infantry troops, should be assembled and works on a large scale put into execution.

These works should be carefully planned in advance so that if it should be impossible to complete them in one year, they can be continued in succeeding years.

[Bridge Training of a Battalion of Mounted Engiters. By Maj. Henry Swift, U.S.A. *Professional Memoirs*, Mar-Apr, '18. 3000 words. Illustrations.]

(This is a short résumé of the work done in giving instruction in military bridges to a battalion of mounted engineers. The matter is presented in such a condensed form that it is not susceptible of further condensation. A number of points of interest to builders of military bridges are brought out, to get the benefit of which the article should be consulted in the original.

Instruction was given in the following types of bridges: frame trestle, king post, queen post, wagon suspension, and ponton bridges with both the heavy and the light equipment. The most important point brought out by the course of instruction was the well known fact that the prime essentials in military bridge work are proper organization and supervision.)

As a general rule military bridges will need to be constructed in the minimum time possible. This can only be done when the officer so arranges his details that all the men can be kept busy during the entire time. An officer detailed to construct a bridge should at once determine what part of the work is most apt to delay the completion of the bridge, and take steps to have this part pushed energetically.

For drill purposes it was found that the best results were obtainable by requiring all companies to build the different type bridges under exactly the same conditions. This creates a spirit of competition, and forces the company commanders to plan their work and details before arriving at the bridge site. Nothing so impresses the necessity of organization upon officers and non-commissioned officers of one company as to have another company, properly organized, complete a piece of work in less than half their time.

[Instruction of Engineer Troops While in Quarantine. By the Regimental Commander. *Professional Memoirs*, Mar-Apr, '18. 1400 words. Illustrations.]

(The presence of an epidemic made it necessary to place quarantine restrictions upon the troops. During the period of quarantine all guard and administrative duties were performed by the companies not in quarantine. The companies in quarantine were kept at engineer instruction during the entire time. The article gives a greatly condensed account, in the form of abbreviated notes, of the character and extent of the instruction given.)

[Sandbox Instruction in Fortification, Reconnaissance and Minor Tactics. By Lt.-Col. V. L. Peterson, C. of E. *Professional Memoirs*, July-Aug, '18. 4000 words. Illustrated.]

In all fortification instruction work, two of the principal considerations are time and expense. One or both of these elements often renders impossible the adequate training of troops. In the winter instruction of the Eighth Engineers, two other difficulties presented themselves—the few men available at one time, and the weather. In addition, experience had shown that the ground in the vicinity was such that digging was slow and laborious. It was decided to attempt the desired training by the use of sandboxes. Boxes 7 by 64 feet were filled with sand to a depth of 2 feet, a vacant mess-hall being used to house them.

One box was assigned to each company, with a lieutenant in charge; one company commander was designated as senior instructor to co-ordinate instruction. Attendance was limited to one platoon from each company each day; the men were graded on the work accomplished each day, and competition between companies was encouraged. In connection with the sandbox work there was held a school in the use and care

of full sized tools as actually employed in fortification construction, methods of excavation, construction of concrete forms, mixing and placing concrete, shaping and joining timbers, etc.

Instruction was given in all forms of fortification and obstacle construction. A scale of 1½ inches to the foot was adopted for all general work, such as trenches, obstacles, gun emplacements, sapping and mining, shell-crater occupation, and the like. For large cave shelters a scale of 1 inch to the foot was used.

For instruction in sketching, sandboxes 7 by 10 feet were used. The sand was shaped into a terrain suitable for showing all usual land forms, the principles of contouring were explained, and exercises were given in tracing form lines in the sand. The box terrain was then elaborated to show all natural and cultural features. In all cases vertical dimensions were exaggerated three times to make the ground forms clear on the small scale. The terrain represented by the sand relief was mapped by the men on a scale of 6 inches to the mile, assuming 1 foot on the sand equal to 1000 feet and taking one-third of each vertical angle to correct for the exaggeration. Horizontal angles were measured with the prismatic compass, and vertical angles with a slope scale. Excellent results were obtained by this instruction. All the men, upon the completion of the course, were able to go into the field and make very acceptable sketches, quickly and accurately.

Instruction in minor tactics was also given on the sketching boxes, to include problems in outposts, advance guard and patrols. The methods were similar to those employed in map problems, but it was found that the sandboxes offered many advantages over maps for this purpose.

As a result of the experience with this form of instruction, the author believes the sandbox method to offer a most excellent means for thoro, detailed and practical instruction in a most interesting manner and in the minimum of time. All those engaged in the sandbox work displayed a noticeable energy, interest and enthusiasm. The methods and the results were very favorably commented upon by many officers of rank and experience, including a number of foreign officers.

—Permanent Operations

See also

Roads, Military

Tunnels and tunneling

ENLISTMENT

See also

Recruiting

ENTRENCHMENTS

See also

European war—Military lessons of the (Article: "The Causes of Trench Warfare, Etc.")

Fortifications—Field

"Trench-foot"

Sapping and mining

—Bomb-proofs

[Use of Corrugated Iron for Construction of Shelters. By Maj. Henry Swift, U.S.A. *Professional Memoirs,* Jan-Feb, '18. 2800 words. Figures.]

(This article consists of a translation of the instructions for assembling the various types of corrugated iron furnished the French army for the construction of shelters. It is, in the main, not susceptible of digest.)

Corrugated iron is a material which may be rapidly utilized in the construction of communications or approaches, as well as of covers of all kinds. The corrugated iron employed is not proof against rifle fire nor the fragments of bursting shell, but it has a rigidity which enables it to sustain the weight of superincumbent banking. Consequently this material should only be used in general as sheathing, since of itself it does not afford sufficient protection.

The earth-covered, semi-cylindrical shelter constructed from two of the standard curved sections gives protection as follows:

With a cover of 75 cm. of earth at the key of the arch, the shelter is safe against field artillery high explosive shell bursting on the surface of the embankment. A covering of from 1.2 to 1.6 m. assures, under the same conditions, an efficient protection against the effects of the high explosive shell from 120 to 155 mm. guns.

Before the war Germany was the only country with rolling-mills capable of manufacturing these plates. At that time France purchased this material by indirect means, using it in the building of subterranean shelters in fortifications. Its application has become general since the war began, the shops of the allied countries having established the plants necessary for its production.

When the nature of the ground or the presence of water renders the construction of underground shelters after the manner of mine galleries impracticable, the curved corrugated iron provides the best means of building shelters on the surface. They are rapid in the making, waterproof and comfortable, as well as capable of resisting the effects of shells from guns of medium caliber, provided there can be an embankment of from 1.2 to 1.8 m. at the crest of the arch, with the interposition of two bursting layers.

Where the shelter is in wet ground, and when the interior is heated, the walls may sweat by condensation. This may be rectified or diminished by the use of paint, preferably a waterproof paint.

—Tactics

See also

Infantry—Tactics—Defense

Tactics

[The Modern Attack of an Entrenched Position. By Col. H. A. Bethell, C.M.G., R.F.A. *The Journal of the Royal Artillery,* July, '18. 3600 words. 1 map.]

This article is based on the published accounts of the German offensive of Mar 21-30, 1918. It is intended as a summary, in convenient form, of the latest German methods, especially with regard to the employment of artillery. The information is taken from Sir Douglas Haig's despatches, and some of the details are

ENTRENCHMENTS—Continued

from Mr. Hamilton Fyfe's correspondence.)

The normal fighting strength of a German division is 12,000 rifles, 54 field guns, and 18 4.2 inch light field howitzers. It has been stated in the press that the infantry of a German division has recently been reduced from 12 to 9 battalions, or 9000 rifles at full strength. However it seems probable that the effective strength on Mar 21 did not exceed 7200 rifles per division. This agrees with Sir Douglas Haig's estimate of 15,000 of all arms to a division.

The artillery is supposed to have been up to strength in guns, and in some cases to have been reinforced by Austrian batteries. Counting a proportionate share of the corps and army artillery, but not the Austrian batteries, the strength per German division on Mar 21, 1918, may be taken as: 7200 rifles, 54 field guns, 18 light field howitzers, 8 heavy (5.9 inch) field howitzers, 8 6-inch guns, 4 medium siege howitzers, 2 heavy (12-inch) siege howitzers.

The German strength on the western front is officially estimated at 200 divisions, of which 85 were in reserve. The attack on the 21st of March was delivered by 40 divisions reinforced on the 22nd by 33 divisions from reserve and on the 23rd by 21 divisions from reserve. This left 31 divisions still in reserve.

The original attack was on a 60 mile front (Vimy to La Fère) but after the failure of the attack on Vimy and Arras it was continued on a 50 mile front from Monchy to La Fère. Deducting 8 divisions still left on the Vimy-Arras sector, we get a total of 86 divisions used on a 50 mile front in 10 days fighting, with a general reserve of 31 divisions intact somewhere behind them, for use in case the attack succeeded in finally breaking thru the Allied line. Some of these divisons were used three and four times. On an average we see that there were nearly 1¾ divisions per mile of front.

This gives the following average distribution:

Infantry: 6.6 rifles per yard of front.

Artillery:

1 field gun	per	19	yards	of	front.
1 light field howitzer	"	57	"	"	"
1 heavy field howitzer	"	128	"	"	"
1 6-inch gun	"	128	"	"	"
1 medium siege howitzer	"	256	"	"	"
1 heavy siege howitzer	"	512	"	"	"

Since 54 divisions were put in as reinforcements, it is possible that their field guns and light field howitzers were not all in position for the week's bombardment which preceded the attack. But we may safely say that the whole of the heavy calibers took part in this bombardment.

General Principles of the Attack

The attacking commander expects, or at least hopes, that the defender will keep his front trench, and his support trench one-half mile in rear, fully manned, as he does not know when the attack will be launched. The men in these trenches will suffer heavily, as both trenches will be practically obliterated by the bombardment. Therefore the resistance experienced here should be slight.

Whenever the defender gives way, the attacking troops must follow him closely, in order to outflank and cut off the portions of the line which have not given way. The principle of limiting the depth of the objective does not apply to an attack in mass with large reserves behind it; on the contrary, it is desirable to push forward as far as possible wherever the defending line gives way, and to take the risk of the salients thus formed being cut off.

The attack must be pushed without intermission. The great force employed, probably at least 10 rifles per yard on the sector attacked admits of many successive waves being launched within one day. As each of the 3 divisions used on the same front secures its objective, the division in rear passes thru it and captures the next line of trenches, and so on. The limit is the rate at which the guns, especially the heavies, can be pushed forward.

One cause of the Germans' rapid progress was the rapidity with which they brought up their field guns.

Preparation for the Attack

This involves great labor, mostly by the divisions in reserve. The whole of the attacking force cannot be quartered immediately in rear of the fighting line; therefore railways must be made to bring up the infantry quickly. Roads must be made and repaired for the artillery to advance by. Battery positions must be dug and ammunition accumulated on a vast scale. Field hospitals and clearing stations must be prepared, and road metal, rations and supplies of all kinds collected.

It was reported by airmen that all roads were made good for traffic right up to the front, in some cases to the support trench. These were repaired as fast as holes were made in them.

Conduct of the Attack

Altho the troops employed on the 50-mile front averaged 1¾ divisions per mile, the infantry attack was not pressed on every mile of the front. The German official report of Mar 22 says: "We stormed the enemy's line in broad sectors." Assuming the attack was pressed on alternate sectors, we get 3 divisions or 1.3 rifles per yard employed in the first 3 days' fighting on the sectors where the real attack was delivered. This would not affect the distribution of artillery, which would want every yard of front it could get and would be equally distributed along the line and concentrated its fire on the real attack sectors.

The scheme works out on the following lines:

Each division attacks on a front of one mile and penetrates one mile before its stops. It attacks in 3 lines: if each consists of 3 battalions, the front of a battalion is one-third of a mile. Each battalion advances in two waves each of two companies. Thus on a front of one-third mile we get six successive waves of 250 men.

The three divisions are launched at intervals which may vary from one day down to five hours. At the latter rate there may be as many as 18 successive waves advancing in one day on the same front. The whole

of this is repeated three times thus gaining a total depth of some 9 miles.

Great use is made of trench mortars and machine guns pushed forward close behind the leading wave. Thus an eye-witness says:

"The first wave to cross No Man's Land consisted of about 250 men with light machine guns, almost shoulder to shoulder. A hundred yards behind came another line of 250 men and then more machine guns. Next, after an interval of 200 or 300 yards came light trench mortars and the battalion staff. Again a space of 200 yards and then, from prepared exits from the trenches, the field artillery drove out into the open in column, forming line of batteries as soon as possible."

The Artillery Program

This is as follows:

1. All the heavy artillery, and the artillery of the divisions first put in, are got into position. If there is room, the artillery of the divisions which are to be put in later also got into position.
2. A week's general bombardment of the enemy's first, second and third lines; of all gun positions, roads, villages, railway junctions, etc., up to 10,000 yards in rear of his front line.
3. Six hours' bombardment of first, second and third lines and gun positions with H.E., shrapnel, and gas shell; wire-cutting up to a range of 2700 yards from gun positions.
4. Rolling barrage from field guns, starting when the infantry go over the top and preceding them all the way.
5. Bombardment of enemy's front trench, lifted on to his support trench when the infantry go over the top. This is repeated as each successive trench is taken.
6. As soon as the front trench is taken, the field guns of one division advance to within wire-cutting distance (if possible within 1500 yards) of the next trench. This is repeated as each successive trench is taken.
7. About one-sixth of the field guns are pushed forward to short range to knock out pill-boxes, machine gun nests and the like.

Expenditure of Artillery Ammunition

For every mile of the 50-mile front, the expenditure for a week's bombardment followed by a three days' attack may be estimated at:

Class	Field gun	Light field how.	Heavy field how.	6-inch gun	Medium siege how.	Heavy siege how.
Number	95	32	14	14	14	3½
General bombardment of one week	100,000	10,000	10,000	5,000	2,500	500
Six hours' heavy bombardment	33,000	5,000	2,500	1,000	500	100
Rolling barrage	25,000					
Bombardment during attack		5,000	2,500	1,000	500	100
Wire cutting	18,000					
Close support	2,000					
Total	178,000	20,000	15,000	7,000	3,500	700
Total per gun	1,873	625	1,071	500	500	200
Maximum rate of fire per hour per gun (during 6 hour bombardment)	57	26	30	12	12	5

The Boche is thoro. When he has figured his ammunition, he orders just double the amount to make sure. That is what he did here.

General Principles of the Defense

The attacker hopes that the defender will hold his front trench, and his support trench one-half mile in rear, fully manned, to guard against a surprise attack in force. If he does so, the troops holding these trenches will suffer so heavily from the bombardment as to reduce their power of resistance to a very low level. Therefore the defender should hold his support trench lightly. He must then either reinforce them when the attack starts, an extremely difficult operation; or else he must resign himself to lose these trenches temporarily if they are heavily attacked, and must hope to regain them by a counter attack under conditions favorable to his own troops.

The object of the defender is to get the enemy out of his (the enemy's) trenches and dug-outs into the open, and then to massacre his successive waves with fire from guns, machine guns and rifles. Even so the remnant of the attacking force will probably suffice to drive out the weak garrison of the front trench and the support trench. These troops must retire, keeping in touch with one another; if one battalion retires while the next one holds out, the latter will be outflanked and possibly cut off. Keeping up control and communication from front to rear during a retirement is a very severe test of staff work, and keeping up lateral liaison is an equally difficult problem for unit commanders.

It is clear that when the attacker has gained the front line trench he can begin again and apply the same procedure to the trenches in rear. But at each advance he must lose a heavy percentage of men, which have to be replaced from reserves, and it is the business of the defender to make this percentage so high as to exhaust the attacker's reserves while his own line, tho drawn back, is still unbroken, and his own reserves intact. Then is the time for the defender to assume the offensive in his turn. If he has carried his retirement from successive lines correctly, he will now enjoy a numerical superiority and will have the advantage of fighting on his own familiar ground.

It must be presumed that at the outset the attacker is in superior force, or that the defender does not elect to apply a force equal to that of the attack. If the opposing artillery forces were equal and equally supplied with ammunition then the defender would return shot for shot, bombardment for bombardment; the front and support trenches on both sides would be wiped out, and the hostile forces would finally be separated by a 2-mile zone of destruction which no troops could cross.

We therefore consider the procedure when the defender elects to retire slowly from successive lines.

The first thing that happens is the S. O. S. from the front trench when the first wave of the attack goes over the top. In response to this, a heavy barrage is put up over No Man's Land by the field guns detailed for this purpose, while other field guns and field howitzers barrage the enemy's front trench and communication

ENTRENCHMENTS—Continued

trenches. As the active defense of the front trench is assumed to be weak, the barrage alone will not stop the attack. But it will cause many casualties, which is the main object of the defender.

Simultaneously the whole of the heavies of the defense open on the attacker's guns, which have just lifted on to the support trench. Observation of fire will be very difficult owing to the smoke of the barrages, even if good O. P.'s are still available behind the lines, and it will be necessary to trust to previous registration and to the airplane photos.

Next follows the stage when the defending troops retire, as per program, from the front trench. They are screened while retiring by a counter barrage; that is to say, the defender's barrage is rolled back from No Man's Land, and is kept in front of the first wave of the attack and behind the last of the retiring defenders. The light field howitzers of the defense now turn onto the evacuated front trench; the heavies continue to fire on the attacker's guns.

The same procedure is repeated in the defense of the support trench, one-half mile behind the front trench.

When the defenders retire from the support trench, the first wave of the attack will be getting within effective rifle range of the defender's field guns and light field howitzers. Now, the defender does not wish to sacrifice the whole of his field guns, but it is most desirable that some at least of these should remain in action till the attack is within 500 yards or less, even if they have at last to be abandoned. They will have a chance of putting in gun fire point-blank at the enemy's masses, and will do more execution in a few minutes than in months of ordinary warfare. Moreover, if the attacker brings up light guns and tanks, it will be absolutely necessary to have guns on the spot (not 2000 yards distant) to knock them out.

If the retirement continues, even the heavies will have to withdraw to fresh positions. And so the defense proceeds, taking heavy toll of the attack at each stage, till the attacker's reserves are exhausted, or till he has to pause to make fresh roads, bring up his heavy guns, and start afresh.

When, by the process of attrition of the attacking force, the defender becomes the stronger, he attacks in turn. This has happened before during the war and will happen again.

Victory will be to the side that has the will-power to endure longest.

[Organization and Duties for Trench Fighting. By Capts. O. N. Solbert, C. of E., U.S.A., and George Bertrand, French Army. *Professional Memoirs*, Nov-Dec, '17 and Jan-Feb, '18. 17,000 words. Plates.]

(This is a transcript of a series of lectures on the subject of "Tactics and Duties of Small Units in Trench Fighting," now being brought out in book form by Messrs. G. P. Putnam's Sons. The articles do not admit of successful digesting. The authors first take up the subject of the organization of the modern company as developed by the entrenched warfare of the present campaign. The duties of the different specialists are given, both for attack and defense, and formations for maneuvering the new type company are presented. Other subjects treated are the general use of fortifications, with the elements of their organization, trench duties, the relief of trench garrisons by fresh troops, use of the various arms and co-operation between infantry and artillery, etc.)

—Use of in European War

[Some Notes on the Turkish Trenches at Sannayait. By Bt.-Maj. W. H. Lang, 16th Cavalry. *Jour. United Service Inst. India,* Oct, '17. 3000 words. 1 map.]

Roughly speaking the Turkish position ran north and south. The Tigris flowed at right angles on its southern flank while the Suwaika marsh protected it from the north. At the time of our attack in February the waters of this marsh were lapping against its northernmost trenches. The country is absolutely flat, broken only by the parapets of our respective trenches.

Our fifth trench was provided with an exceptionally high parados into which were arranged observation posts. These posts gave us a command of 8 feet but owing to their visibility were unhealthy spots. The height of this parados defiladed the ground behind it and allowed us to move about in moderate safety.

The river bank was fringed for some 100 yards with thick undergrowth, reaching a height of four feet. Our respective front lines were from 80 to 150 yards apart.

"No man's land" was quite level but pitted badly with shell holes while the river edge was covered by the undergrowth. This undergrowth was barely an obstacle, altho it was the scene of many bloody affairs of bombers and snipers. Owing to thorns it was most unpleasant to crawl about in. Shell holes formed the only cover between our front lines, not the vast shell holes of Flanders, only craters some four feet deep.

The Turkish front line showed once again the strength of an irregular trace. Airplane photos led us to expect an irregular trench but not such a one as this. In general outline it was a wavy line with salients covering re-entrants, but beyond that there was nothing regular. No two firebays were the same length or even depth, no two dugouts the same size or situated in the same part of a bay, no two traverses were of the same thickness and even the breadth of the trench varied considerably.

The front line itself was a single trench with no inspection trench behind it, in some places over 10 feet deep, in others little more than 6 feet. In breadth it averaged five feet but was much narrower at the traverses.

Revetments of all kinds had been improvised. Sandbags, floursacks, brushwood, marsh reeds, rabbit wire all played their part.

The parapet gave a low command of about one foot, but the parados was ample and irregular. The firing step was normal; above it were holes for storing bombs and ammunition, while below it were dugouts. These latter consisted mostly of long holes of varying lengths about 4 feet high entered by slits some 2 feet broad between the firing step and the bottom of the trench. The roofs were shored up by planks and

timber and were proof against our heaviest artillery. In many places protection was afforded by scoops in the side of the traverse. These were all very deep and broad as the Turk had to contend against enfilade fire from the other bank of the river which was in our hands.

A listening gallery had been dug some 25 yards east of and parallel to the front line. It ran from the river and consisted of a tunnel 3 feet 6 inches square, the roof of which was 2 feet below ground level. Planks and corrugated iron shored up with timber kept the roof from falling. The gallery crossed many saps and relied on them and on holes in the roof for air. There were no signs of mines or electric wires nor was any ace found of a wire for obtaining induction from our telephones. It seemed to be purely a defensive gallery against our mining.

There were many saps forward from the front line mostly under 50 yards long. Some were used by bombers and snipers but in none were machine gun emplacements seen.

The second line, where it existed, was used as an inspection or communication trench. It did not appear to have been lived in nor was it provided with dugouts, nor was there any wire entanglement in front of it.

As our troops had not consolidated the third line it was found more in its original state. There was a low wire entanglement some 15 yards in front of the trench. This wire was 10 yards broad on poles 1 foot high. It was countersunk and protected by a parapet 1 foot high. Besides protecting the wire, the parapet gave the impression that it was the enemy's third line and caused a good deal of shooting to fall short. The class of barbed wire varied considerably but it was mostly a very light, poorly barbed, wire, not nearly as formidable an obstacle as our barbed wire affords.

The third line itself consisted of a fire trench and in some places a support and also an inspection trench. When single, the fire trench was 6 feet deep, provided with a fire step, irregular traverses and a few dugouts with overhead covers. The sides of the trenches were generally not revetted and none of the dugouts were more than splinter proof. With the exception of those in the front line, no dugouts had been provided with overhead cover sufficiently strong to resist anything heavier than an 18-pound shell. In the front line only was revetting material used, the remaining lines not even having sandbags.

No machine gun emplacements provided with overhead cover were recognizable in the first two lines and the only emplacements seen were sited for oblique fire, without overhead protection. In these great care was taken not to disarrange the trace of a trench and so give away the position to airplane photographs.

One big minenwerfer (throwing 150 pounds) was inspected. The pit was 10 feet deep by 10 feet by 9 feet, partially covered with light overhead cover as protection from aerial observation. It relied on the depth of the pit to hide the flame on discharge. The walls were partially revetted and the dugouts in the vicinity were safer than usual.

The main system of communication trenches were deep narrow trenches, in some places 12 feet deep. Their irregularity must have largely contributed to their safety. There were very few trenches along which a stretcher could have been taken and there was no deliberate straightening of the last length of a trench so as to check a bombing attack.

The only telephone wire ran down to the fourth line and consisted of a bare wire suspended on the top of wooden posts, which were fixed to the side of the trench and projected some 2 feet above ground level. Crossing places were arranged and, apparently, every station on the circuit was tapped in to this wire.

The river was too high in February to see how the Turks used to draw their water during the summer but apparently they dug deep reservoirs just north of the river bank and filled them by hand pumps, the piping of which was carefully concealed.

[Trench Organization. By Gen. Rene Radiguet *Professional Memoirs,* May-June, '18. 5700 words Illustrations.]

(An extract from "The Making of a Modern Army and Its Operations in the Field," by Rene Radiguet, General of Division, Army of France, published by G. P. Putnam's Sons.)

(The author discusses in a general way the plan of a modern entrenchment system with its multiple lines and boyaux. The different means employed for the protection of the troops and the defense of the positions are briefly recounted. The use of the artillery is touched upon, and there is some discussion of the character and importance of the transportation system in rear. Mention is made of the essential work done by the aviation service under modern conditions. There is little in the article with which our readers are not already familiar.)

EQUIPMENT, Military

See also
UNIFORMS

ESPIONAGE

—In European War

[Prevention of Espionage and Leakage of Information. *Infantry Jour.,* Aug, '18. 1600 words.]

The enemy obtains his intelligence thru spies, by questioning prisoners, by the examination of documents obtained from prisoners or dead, and by more indirect means. Officers and soldiers must not discuss in any way, except in line of duty, any matter referring to the movements, numbers and morale of the troops or their Allies, the state of their supplies nor the extent of casualties. They must never mention their unit in connection with the place where it is stationed. The utmost care must be taken by all ranks in talking either to, or in the presence of strangers. Spies may wear the uniform of Allies, some have obtained employment with units as cooks, mess-waiters, etc. The telephone is at all times an unsafe means of communication. The safety of troops depends on the most rigid adherence

ESPIONAGE—Continued

to the orders issued regarding the use of telephones. All ranks must be as reticent when on leave in England as when they are in France. The censorship regulations regarding written correspondence must be complied with. The most effective means of checking activities of spies is to control the movements of all inhabitants. Any person who is suspected of espionage during mobile operations should be arrested and turned over to the Provost Marshal branch. The papers of any person in uniform, of whatever rank, whose words or actions are suspicious should be examined by any officer, N. C. O., or man on the spot. During stationary warfare a civilian suspect should be reported to the nearest Intelligence Officer or Intelligence policeman. In territory which has been evacuated by the enemy in his retreat there may be agents left behind—either in uniform or dressed as civilians—and concealed where they may observe our movements and signal them to the enemy. Papers of every sort must be burned before troops move from a billet or bivouac. If a man is taken prisoner he should tell only his name and rank. Every man in the ranks must do all in his power to combat the enemy's system of espionage. It is a national duty to make a false statement in answer to questions concerning his movements. The facts concerning the arrest of persons, claiming to be employed on special missions by the Allied armies, should be at once communicated to higher authority in order that bona fide agents may not be delayed unnecessarily.

ESPRIT

See

MORALE

EUROPEAN WAR

See also

CANADA—EXPEDITIONARY FORCE FOR EUROPEAN WAR

SAPPING AND MINING—USE OF IN EUROPEAN WAR

[Note. *Army & Navy Jour.*, Dec 8, '17. 250 words.]

The Inter-Allied War Conference, on Dec 4, issued an official statement explaining some of the results of the sittings. Among these were "the creation of a Supreme Inter-Allied Naval Committee," and that "military unity of action has been placed upon the course of certain realization by the Inter-Allied General Staff which is at work upon an established program of all military questions." It was also announced that: "The Allies, considering that the means of maritime transport at their disposal, as well as the supplies at their command, ought to be utilized in common for the conduct of the war, decided to create an Inter-Allied organization with a view to co-ordinating action in this direction, to establish the common program constantly kept in mind, and enabling them, while utilizing their resources to the full, to restrict their imports in order to release as much tonnage as possible for the transport of American troops.

[Work of War Mission. *Official Bulletin*, Jan 2, '18. 1100 words.]

(1) After conferences extending over approximately 30 days with the chiefs of staff, members of the general staffs, and commanders in chief of the allied armies on the western front, as well as with the highest civil officials of the respective Governments, the extent of the military effort to be aimed at by the United States was clearly determined.

(2) With this determination in mind negotiations were carried on looking to the pooling of resources for the mutual advantage of all of the countries engaged in the war against Germany. The contribution of the United States to this pooling arrangement was agreed upon. The contributions likewise of the countries associated with the United States were determined. This pooling arrangement guaranteed that full equipment of every kind would be available to all American troops sent to Europe during the year 1918.

(3) Unqualified support to the resolution adopted by the Inter-Allied Conferences looking to the creation of an Allied Advisory Board charged with the duty of advising the shipping authorities of each nation concerning the allocation of tonnage so as to permit the American military effort to be realized.

(4) Full survey made of problem of debarkation in Europe of American military forces and transportation of such forces and supplies to the bases of military operation.

(5) Arrangements made for fullest co-operation between the United States, Great Britain, and France in the production of military instruments and supplies of all kinds.

(6) Plans made for the proper organization under naval and military control of ports of debarkation of troops and discharge of cargoes looking to the most economical utilization of tonnage.

(7) Participation in military deliberations of Supreme War Council as a step toward efficient and centralized unity of control of military operations.

[Deductions from the World War. By Maj.-Gen. Baron von Frietag-Loringhoven, General Staff, Imperial German Army. *La Guerra y su Preparación*, Nov, '17. Translated from the *Folgerungen aus dem Weltkriege*. 16,000 words.]

The Political and Economic Situation of the Central Empires.—The distribution of forces at the beginning of and during the present war has been decidedly unsatisfactory for the Central Empires. The Allies have kept together, and in addition have been joined by the distant and once allied German powers, Rumania, Italy and the United States, which even before February, 1917, helped the Allies with all sorts of war material and money. Tho Turkey and Bulgaria may have given valiant aid to Germany and Austria, it is plain that they could not establish a balance of power. England has succeeded in maintaining unity, and as the destruction of the Central Empires grew more difficult, she and her Allies rose to meet the increasing task. As the hope of reducing Germany militarily and by the blockade diminished, the necessity of doing so geographically, thru commercial treaties, increased.

England demonstrated her willingness to fight by creating an immense army based on the principle of

compulsory service. With this change she altered her former custom of making her Allies fight her wars.

England became a great colonial and maritime power in the wars against Louis XIV. The Seven Years' War made her a world power, but it took the American Revolution to make her an international political power. Political power came to England and Germany with the formation of new nations; in the 18th and 19th centuries in America and the 20th century in Japan.

Questions of world politics and international political economy had a secondary importance up to the time of the War of 1870-71. Then Germany was still an agrarian state. Up to the present those questions had not come sharply to the front. But at the beginning of the war Germany was placed in a most unfavorable position. Importation of raw materials and manufacture and exportation were our livelihood. As far as political economics were concerned nothing could be imagined worse than our position. The General Staff had not made preparations to meet any such contingency as arose.

The rapidity of Germany's growth as a manufacturing country prevented us, to a certain extent, from realizing the necessity of providing for our economic situation in case of war. Continental security was much more important. For this reason our diplomats have often been blamed for our present estranged condition. The consequences of being isolated were soon felt in the Central Empires. We have developed our economic position to its highest point, but our enemies have been able to withstand defeats that in other wars would have been absolutely decisive.

The defeat of Napoleon has been attributed to the English Navy cutting off his bases of supplies and the continental states of those times were more essentially agrarian than at present. Tho the Central Empires are now well able to sustain themselves for a long time, still we had to adopt submarine warfare as a defensive measure. The unlimited use of this new and formidable weapon, which the economic difficulties it produces for our enemies and for neutrals will do much to hasten the end of this great war produced by economic conditions.

The present war proves irrefutably that Germany must always maintain her maritime aspirations. How this is to be done will be determined later. Our geographical positions will always oblige us to couple the exigencies of national and international political economy. In the present war economic considerations have already played an important part. The occupation of Belgium and the industrial and coal region of Northern France, as well as that of Poland, Courland and Lithuania have given us considerable economic advantages, with a corresponding loss for our enemies. The object of the Serbian campaign was to establish land communication with Turkey as well as to gain the Bulgarian alliance. This campaign gave us not only an added fighting front, but also the chance to exchange products with the Balkan States. The war against Rumania, which we did not desire, brought with its victory a year later another increase of economic advantages and the security of our position in the Balkans.

To-day as yesterday, war is won by the sword, but to-day political and economic considerations have a great influence on the final victory. We feel their importance at each step in this war.

The American Civil War was in reality an economic war, the first one of the modern epoch. The Northern states being manufacturers wished a protective tariff, while the Southern states being producers wanted free importation and exportation. We could have learned something from the War of Secession. Our enemies did not realize our position until they found it impossible to break down our armed resistance, when they began to explore our economic situation and make it worse. It took a war to show us the importance that economical considerations have in war. Even in our day a war of long duration was not considered possible.

For England it was a question of self aggrandizement and the destruction of the principal competitor. England did not think the war would last. Not until she saw that her allies could not destroy the principal competitor did she prepare a large army for a long war. Even such a keen mind as Field-Marshal Count von Schlieffen stated that for the present age, where commerce and industry are so essential to the life of a nation, only a rapid decision could win a war. Nevertheless, a prolonged wastage of forces has been sustained. In contradiction to everything that was expected, the world has supported a prolonged war. It is true that it has caused destruction of values never before thought possible.

Psychology of National War.—The present war has revealed the psychology of war with great national armies. (The author discusses the French Revolution, the wars of Napoleon, and the War of 1870 as examples of the improper mobilization of national forces for war. He deals with the deficiencies of the French.)

In 1914 we (Germany) faced for the first time a French army organized on the principle of obligatory service, and in addition a people who had been taught to hate everything German. The surprising victories of our armies in the first days of the war made the hatred stronger. These were simply due to a proper naval and military preparation so that upon the declaration of war all nervousness ceased and our military organization moved smoothly so as to give the maximum service. This caused the idea to spring up that Germany had provoked war intentionally. The conscientious execution of the will of the people by the state was simply misinterpreted.

In the French army the idea is kept constantly alive that the French soldier is not only fighting to liberate the conquered country but also for the future safety of France. The French soldier is a product of the race rather then of military training and the conditions of the race are clearly brought out in this war. The French soldier fights with absolutely no thought of death. For this reason it has been possible to employ entire divisions in close order in attacks that never could be successful. From ancient times the Frenchman has been a good fighter. Compulsory training has

EUROPEAN WAR—Continued

made him even better in this war. He has shown all the better soldierly qualities and none of the lower ones.

England has become a powerful military nation during the course of the war. The process has been gradual and the enthusiasm for the war has grown with the army. Trench warfare permitted a long training period for English recruits, so England has a well-disciplined fighting force, but not as good tactical units as the French or as cohesive as the original Expeditionary Force. The English have the technique of battle very highly developed, but they lack battle tactics. In place of volunteers England finally sent a national army to France. But volunteers or national army, they served the political ends of England in her economic war against Germany. Individual realization of the task before them has made England's national army very powerful. The Englishman is less impressionable than the French but sticks to his ideas once they have formed.

We have been embroiled in a war against enemies who have been influenced by collective suggestion. This has caused the worst demonstrations of ferocity and destruction not seen since the Religious Wars. It shows the lack of spiritual progress in mankind, and the wide breach between civilization and Kultur. The violence of this war, which has caused even international law to disappear, is due to the fact that entire nations are taking an active part in it thru obligatory service. The capacity of armies for receiving and sustaining punishment has been greatly increased.

All of us, the officers as well as the troops, are susceptible to human weaknesses and it is certain that German soldiers are not in general individual heroes. This fact is revealed in the present war in which the strong suffer with the weak. In Transylvania and Galicia the troops showed wonderful bravery and hardihood. The sufferings of a long and tiresome war would not have been withstood except by a national army which always has the desire to see the war ended.

We will never be able to realize in full the high sense of duty and the force of resistance demonstrated by our troops in the face of a much larger enemy. The Landwehr and Landsturm have undergone terrific sufferings and have come thru remarkably well. It is true that modern surgery and hygiene have done much to preserve the strength of national armies; almost 90 per cent of our wounded are returned to duty.

Russia gives us less surprise than the rest of our enemies. It is true that the Russian mobilization was faster than we expected, but their organization was heavy. Our great mobility offset their great numbers.

The Russian army became nationalized by conscription in 1874. The Russian failures in the far east are due to the fact that the Russian army is unsuitable for modern warfare. The Russian peasant is too ignorant to understand discipline and to make a good soldier. The moral forces in an army affect its fighting ability. This was demonstrated by the actions of the Russian soldiers in the Russo-Japanese War.

[The Course of Victory. By XX. *Revue des Deux Mondes*, Sept 15, '18. 15,000 words.]

The sudden turn of fortune which permitted the Germans to attempt their great drive in March, and the subsequent arrest of this gigantic thrust in July, where, on the memorable fields of the Marne, already indelibly written in history as the point of arrest of the *Kultur* crusade, the armies of France and her allies halted the forward movement of the German Army on July 15, and 3 days later launched their own counter-thrust which was to regain all lost territory, are all most pertinent facts for consideration in connection with the present allied efforts to force a decision which will guarantee future freedom from aggression. Inasmuch as France and her allies are unbending in their demands, the whole war may be considered as but one problem whose only solution is victory, and to chronicle the great campaigns and critical points is but to follow the courses which lead to victory. Let us, therefore, follow them one by one and see the conditions which led to the present situation, and read from the past the hopes of the future.

Verdun.—Here, in the great struggle at Verdun in 1916, the Germans made their first great attempt to break thru the French lines at any cost. It cost them just 500,000 men and they did not get thru. The Germans had placed too much confidence in their preponderance of artillery and more modern and effective equipment. They had sadly undervalued the bravery of French troops, and the determination of the French will. *"Ils ne passeront pas"* meant nothing to them until they tried it. After 4 months of fighting of such intensity that there was no precedent in history, German artillery had pulverized practically everything in range, but there is where its limitations were reached, for by infantry assaults which followed, they were unable to break the French line, and succeeded in driving only a small salient into the French front at one point, which they could not occupy in force for fear of being cut off and captured. The great stroke had broken down and soon resolved itself into the ordinary type of trench warfare, something which the Germans had hoped to avert, and laid their plans accordingly. Inasmuch as they did not break thru and turn the flanks of the French and cause the general retirement of the whole Allied line, the attack on Verdun will go down as a colossal failure for the Germans, and a magnificent proof of the high quality of French morale.

The Battle of the Somme.—Profiting by the experiences of Verdun, the French undertook a breaching operation of their own, and selected the battlefield of the Somme as the place. The operation had for its object the cutting of the great line of communication which fed the German lines to the north. The plan was to attack on a 40-kilometer front, after proper artillery preparation. The enemy thus engaged would have to draw from other sectors and the Franco-British forces were to take advantage of these opportunities. The plan was good, except that it overlooked the element of surprise, and the enemy was able to make counter measures in the same proportion as the Allies planned to attack. However, had the plan been a suc-

cess, the Allies were prepared to dash thru the breach in the line, and with the aid of the cavalry, harass the fleeing Germans in the open, and completely demoralize them, so that the retreat would result in a route and a decisive victory be gained that would necessitate a general withdrawal of the Teutons from Allied soil, and perhaps gain a complete and sweeping military decision acceptable to the Allies.

July 1, 1916, the campaign commenced with initial successes for the French, but in the sector where the greatest effect had been made on the Germans, the Somme proved a natural barrier to limit their opporations, and the cavalry which was to get in rear, was inadequately armed for fighting against the German infantry, and also proved no match for the machine gunners who were posted thickly to stop the advance and facilitate the German retirement with a minimum loss. From a shock attack on an enormous scale, the Battle of the Somme resolved itself into a wearing-down process of trench warfare again, with the Allies on the offensive and in the ascendancy. This battle had been timed to take place simultaneously with a Russian and an Italian offensive, due to the fact that the enemy had constructed a large line of communications from the Russian front to the western front, in order to switch troops from one front to the other in case of need. Once, however, the initial stroke had been absorbed, the great campaign was broken up into many smaller engagements of a more limited nature, but by the brilliancy of which the French were able to wrest many important positions from the Germans, and later cause the famous strategic retreat of von Hindenburg the following spring.

The Hindenburg Retreat.—As the result of the attacks of the Battle of the Somme, the enemy strengthened his lines of defense by substituting concrete shelters in place of the more improvised type of dugout, and built successive stretches of trenches in rear of his first line positions to eliminate any possibility of a breaking thru, such as the French had planned at the Battle of the Somme, and they themselves had hoped for in their Verdun campaign. To the rear of these a great system of trenches was constructed as a barrier to the advance of the Allies, and a refuge for the German armies in case of first line reverses. So strong were they that von Hindenburg himself said that it would take the Allies 30 years to get thru.

The Allies were all this time during the winter of 1916-1917 busily engaged with their preparations to oust the Germans from their intrenched positions and drive them back by sheer force. So formidable were these preparations that the German General Staff admitted their efficacy and decided that a strategic retreat conducted so as to take advantage of the works which had already been constructed would be less costly than attempting to hold the Allies in the face of the preponderance of war material which they had massed against them. This plan was adopted, and with the opening of spring weather in March, the Germans withdrew from their front line positions where the Allies had prepared to attack, and fell back to the already prepared Hindenburg Line. By doing this they had upset the plans of the Allies which had taken 4 months of hard preparation. However, the Allies were not blind to the situation, and followed so closely on the heels of the retreating Germans that their losses were greater than anticipated, and whereas the Hindenburg Line was too strong for the Allies to get thru without great preparations, the rapid progress of the pursuit left the Allies on the offensive, even until they could bring up their heavy guns to pound the new German lines.

In Germany the retreat was heralded as a great triumph of warfare, a testimonial of the magnificent genius of Hindenburg. The Allies would not admit so much, but the fact remains that Ludendorff had selected his own battlefield where the Allies would have to give him battle on his own plans. Furthermore, the Noyon salient which offered the Allies great advantage was thus no longer a tempting opportunity, and instead, Ludendorff could dictate the conditions under which the following struggle would be waged.

Faced by the example of Verdun where in 2 days the French had recaptured Forts Vaux and Douaumont, advanced 5 miles and taken 16,000 prisoners, thus undoing the 4 months' work of the Crown Prince's Army, the Allied General Staff was completely won over to a scheme of concentrated frontal attacks after proper artillery preparation. With this idea in view, the Allies prepared to blast their way into the Hindenburg line on the theory that "the artillery conquers, the infantry occupies." Inasmuch as the artillery which the Allies would have to use to reach the rear areas of this trench system would of necessity have to be of large caliber and difficult to maneuver, the fact that they planned an attack on the Germans in less than one month after their retreat contained an element of surprise which was for its first time being employed on a grand scale. It also was a measure of the ability of the Allies to retrieve the general situation and remain on the offensive. The infantry was all ready to rush thru the gaps prepared by the artillery.

The lessons learned from the Allies caused a general change of plan for the Germans. A reorganization was necessary according to Gen. von Below, who claimed to see the weaknesses which had permitted the Allies to win their victories. The changes included permanent general staffs of increased numbers limited to special zones of operation, a reassignment of the staff officers to new duties, liaison between the various arms of the service, equipment and instruction for the troops, and a new defensive scheme. This latter was not to be any longer the usual type of trenches paralleling each other, but a defensive position of great depth. The outer lines were formed by taking advantage of shell craters, camouflaged and improved, and then armed with machine guns. In this way any surprise attacks of the enemy would be held up until the reserves could counter attack. The success of the scheme was based on the fact that the enemy would be worn down by the first line resistance, and the assault of the fresh counter-attacking troops would easily crush his effort. The scheme was essentially a defensive one which relied on the counter attack for its success, and offered few opportunities for the offense.

EUROPEAN WAR—Continued

The Summer of 1917—Flanders, Malmaison.—The April offensive and operations on the Chemin des Dames proved that the scheme of concrete shelters, or "pill boxes" was inadequate protection against artillery fire, as well as the more extensive concrete shelters. So far they had proved to be man-traps in an attack by the enemy. However, the German General Staff decided on a scheme of strong points protected by concrete shelters, and improvised the shell craters instead of regularly constructed lines these for the purpose of camouflaging their positions and depending on the power of the counter attack to suppress Allied attempts to break thru, and thus demoralize his offense. Both sides exhausted their ingenuity to find means to off-set the virtues of the defense of depth; increase in the caliber of the guns, greater and more destructive projectiles, ingenious camouflaging devices, barrages of varying calibers, according to the needs of the situation, etc., were all adopted to make the scheme successful. However, these means could not be a success unless the commanders kept up their communications with the isolated units. This they could not do, and on account of it the whole scheme of defense of depth was to collapse.

The battle of Malmaison, in spite of its limited character, proved to the French command that they had the solution of the problem, viz.: to attack in force at a well selected point and drive a wedge into the system which would necessitate a withdrawal in the adjoining sectors. At Malmaison the French pushed forward to the Ailette in the neighborhood of Pinon and threatened the Chemin des Dames from Chevregny to the region of Cobeny. This necessitated a general retirement from the Chemin des Dames to the north of the valley.

The Surprise Attack on Cambrai.—At the battle of Cambrai a radical departure was made, in that there was no artillery preparation to warn the enemy that an attack was impending. Taking advantage of the fog, on the morning of Nov 20, 1917, a great number of tanks were assembled in the sector opposite to Cambrai. At daybreak these tanks moved to the attack without any warning. So completely surprised were the Germans that many of them were caught asleep in bed. The infantry followed the tanks closely and gathered in the prisoners. Only the lack of reinforcements prevented the fall of Cambrai itself, but the British were content to hold this part of the Hindenburg line which they had overrun, and draw from the lesson of this battle the value of the element of surprise in attack on a fortified position, as well as the merits of the tank, which were here used in force for the first time to break down the enemy's obstacles and attack in conjunction with the infantry.

The Russian Defection and the Problem of Effectives.—From the time of the Russian Revolution the demoralization of the Russian Army did not cease. All the belligerents were aware that a collapse was near and determined to profit by it. The British, in spite of their losses in April, launched an offensive in Flanders in hopes of pushing as far ahead as possible before German reinforcements could be brought from the eastern front to strengthen the western battle line. France was in an unfortunate position at this time when her army was just passing thru a period of moral depression. Even after a reorganization of the 108 infantry divisions, there was yet a deficit of 50,000 men in the French Army.

After a careful survey of the situation the German General Staff decided to concentrate against Russia and eliminate her as a belligerent. Taking advantage of the spirit of discontent and unrest which caused the disorganization of the great armies of Russia, the Germans now faced the Russians with a superiority of men and material. Of the 234 divisions of the German Army, 155 were left on the French front, while with the rest they planned operations against the Russians. The result was that the Russo-German armistice was signed Dec 20, 1917, and Feb 9th the Treaty of Brest-Litowsk officially eliminated Russia from the war.

With Russia out of the war it was only necessary to keep a limited number of troops there to occupy the country and enforce the terms of the peace treaty. The next move was, therefore, to transfer from the eastern front as many effectives as possible and plan an offensive campaign on the western front which would force a military decision favorable to Germany.

The problem of effectives now became the topic of the hour. Whereas the Allies were counting on the arrival of reinforcements from America to turn the tide of victory in their favor, yet these troops had not yet arrived in sufficient numbers to be felt, and most of these needed a certain amount of necessary training which would take several months. Thus the spring of 1918 found Germany with a numerical superiority of men with a margin of 700,000 over the Allies, as well as a superiority of heavy cannon of a standard type. With 207 divisions ready for battle, and 80 in training, the Germans had an advantage of 50 divisions over their adversaries, all trained in a standard way, and all of the same race, another advantage over the varied composition of the Allied Army.

The new German method for the spring offensive of 1918 took into account means hitherto untried in the German Army. Shock troops and surprise were to play an important rôle in the future operations. To effect this, carefully selected and trained shock troops were to replace those normally occupying the sector chosen for the attack. This change would not take place until immediately before the attack, so that not even the Germans would know the plans of their General Staff. Furthermore, the use of poison gas shells in great numbers would be used to demoralize the enemy and inflict as many casualties as possible. All changes in dispositions were to be made at night; the shock troops always to be numerically superior to the defending force, and the bombardments which preceded the attack to be of short duration, but violent in character. The infantry battalion was to be the typical unit, and would work more or less independently. The brunt of the fighting was to be borne by the riflemen, who were to be relieved of carrying grenades, either rifle or hand, and the machine gun work was to be done

by machine guns mounted on wheels. In each company there were to be 3 classes of fighters, viz.: those assigned to machine guns would be called the element of fire, the *stosstruppen* would be the offensive element, and the rest would constitute the support. The battalion was also to have a separate service of supply for rations and munitions, a liaison service composed of telegraphers, signal men, and couriers, and a certain number of extra officers and men for replacement purposes. To all intents and purposes the battalion became an independent unit to progress as far as it could force its way into the enemy's lines.

The German Attack, Mar 21, 1918.—Following out the details of the system to be adopted, the Germans massed 40 divisions of shock troops opposite the 10 divisions of Gen. Gough's Fifth British Army. The line of attack extended from La Fère on the Oise to Croiselles on the Sensée, and was about 50 miles in length. Whereas von Ludendorff has been severely criticised for selecting this point, yet he did so for two reasons, viz.: that it marked the point of union of the British and French armies, and also it was the country over which the Germans had retreated the previous spring and had devastated thoroly, so that they were perfectly familiar with the terrain.

However, the Germans had underestimated the strength of the British. They had hoped to break thru and cause a complete demoralization and rout. They did break thru on the front near Cambrai and caused a general retirement, but the flexibility of the line robbed them of the fruits of their success. Following up these initial successes, the Germans continued to advance, hoping that they would not give the beaten British forces time to reform and counter attack, nor time for reserves to be rushed to the scene. But fortune was against them. The system of fresh German divisions resuming the offensive from day to day against the worn-out British troops had permitted them to advance about 10 miles a day until they had reached a depth of advance of about 40 miles, yet the more they advanced, the further they got from their heavy supporting artillery, and the nearer they got to that which the Allies had rushed up to meet them. It was also disappointing to the Germans that the Allied Army had remained intact and they had not achieved their original purpose of separating British from French.

Thus the German Armies surged forward in hopes of now driving the line back in the center, and if possible menace or capture Paris, while at the same time they planned a campaign which was to follow and to have the channel ports as its objectives, thus turning the flanks of the Allies to the north and destroying communications between England and France. There must be no let up on the great drive, for the whole plan depended upon not allowing the Allies time to recover from the initial shock. But here is where the plan miscarried, for the Allies did recover themselves on Mar 31 and the first stage of the great German offensive had been definitely halted.

The next attack of importance took place on a 15 mile front between the dates of Apr 9 to 14. In this drive the Germans advanced to a depth of about 12 miles and took Bailleul and Armentières, and outflanked Béthune. The next move was to take Ypres and cause the retirement of the Belgian line from Dixmude to Nieuport, but this failed.

While these operations were going on to the north, the Allies had recovered sufficiently to offer appreciable resistance to the German armies of von Hutier to the south, and were now even counter-attacking. By the middle of April both armies had established their positions and neither would give ground.

The next stage of the German offensive was commenced by the attack which opened the Battle of the Aisne, May 27, 1918, and continued until June 4. The object this time was Paris. With the slogan *nach Paris,* the German Armies moved against the French with a numerical superiority of 4 to 1. The old system of new German divisions carrying out from day to day the gains of the old, won for them a territorial gain in the center which at its deepest point was about 37 miles. However, the flanks at Reims and the forest of Villers-Cotterets did not yield, and the Germans reached the Marne at and to the east of Château-Thierry and made their furthest advance June 5, 1918. Paris, the objective of the advance was lost, because instead of consistently carrying out the original plan, the German General Staff had conceived the notion that they would deflect their forces temporarily to take the channel ports, and then later, seeing the weakness of the Allied line in the center, advanced to take Château-Thierry and cut the line of communications between Paris and the East at this point. These modifications in the plans which had already been undertaken proved fatal to von Ludendorff.

French Morale.—With her land devastated by the ravages of four years of war on her soil, and now the enemy in the ascendency and gaining every day, the question naturally arises to explain why French morale did not suffer a defeat and the French Army become demoralized and yield to German superiority and organization. The answer is found in six centuries of glorious history which would have made it inconsistent that they should. Another moral factor, which also proved to be material as well, was the promise of aid from America. With this confidence the French went into battle to die, knowing that their work would be carried on to completion by this new ally whose green levies were pouring across the sea at a remarkable rate and who would soon be present in sufficient force for independent and aggressive action.

The next German effort at an offensive commenced June 9, but was promptly arrested June 11. This occurred in the neighborhood of Ribécourt. West of Soissons in the edge of the Forest of Villers-Cotterets he gained local and initial successes. But in both cases the German losses were out of proportion to their gains, and could hardly be called victories. In the operations around Belleau-Bouresches the Germans had their first contact with the Americans and grew suspicious of their value, as underrated by the German General Staff.

The German Peace Offensive, or *Friedensturm,* was the next great move of von Ludendorff. A comparative calm had reigned on all fronts from the

EUROPEAN WAR—Continued

middle of June to the middle of July. In this time von Ludendorff was preparing a great offensive which was to cap the climax of all his previous successes which had brought him to this point in the offensive. But the Allies, too, had some plans of their own. Their greatest difficulty was to know where Ludendorff would strike, and when. To gain this information they had noted where explosions behind the enemy lines showed the accumulation of ammunition dumps, had kept their airplanes busy observing and reporting all activities, and in the region of Monts maintained a signal station equipped with pigeons, wireless, and couriers. In this way they were able to make their dispositions to counter any move which the Germans might make.

The plan was daringly laid and brilliantly executed. With an inferiority in numbers of men, the French were relying solely on the bravery of the poilu to offset this and lead France again to victory. Then too, the audacity of planning an offensive at the same time as that of the enemy was too stupefying for the German High Command to grasp. Thus the element of surprise was to stupefy and bewilder him at the moment when his plans were the most upset, and while he fumbled, the poilu would take care of the situation in true French style. The reason for this counter-attack before the Germans could get under way was due to the fact that the German front lines were poorly fortified, thinly held, and therefore easy to penetrate. The results showed that the plan of the German offensive did not permit of proper defensive measures without seriously deranging the original plan.

In accordance with this plan, the French awaited the launching of the German attack on July 18, and then attacked his right flank between the Marne and the Aisne. The surprise was complete, and that day marks the turning point of the German offensive, if not of the entire war.

The French command had kept the plan a secret, but had made all provisions for following up the successes which were to be gained from it. Not even had they allowed an artillery preparation to precede the infantry assaults, for the tank not only took the place of the gas shell, but also of storm troops as well. The results of this offensive, and the subsequent French counter-offensive are too well known for repetition. The German Armies found it necessary to beat a hasty retreat to seek the shelter of their old lines to reorganize, but the vengeful Allies with the rapidity of their advance rendered even this doubtful of results.

In conclusion let it be said that the situation from 1914 to 1918 has rested on the value of effectives available on each side, and that the latest German defeat may be attributed to the fact that the arrival of the Americans so greatly increased the Allied forces at a time when German man-power was on the wane that the situation had but one solution which will in a brief course of time be achieved—an Allied victory.

—Chronological History of, By Theaters

[Digested from miscellaneous sources; covering the month of December, '17.]

In reviewing the events of the last month of the eventful year of 1917 it may be well to consider briefly the events that have occurred in this, probably the most dramatic year of the war. At the beginning of the year the Allies were undoubtedly masters of the situation. Their armies on all the fronts were stronger, more fully equipped, and in better spirit than at any previous period. It appeared that before another winter the war should be well on the way toward a conclusion that would settle once for all the unbridled ambition of the German leaders.

So evident was it that the Allies were possessed of an overwhelming weight of men and guns that the Germans on the western front, at the very beginning of the season, fell back in their great retreat, hoping thus to disarrange the Allied plans, and at least gain a brief respite from the smashing attacks they well knew confronted them. This hope was of brief duration, however. The Western Allies, and particularly Great Britain, began at once to deal them sledge hammer blows. First at one point, then at another, the attacks fell, following each close upon the heels of the last. Each attack yielded thousands of prisoners and wrested from the Germans more and more of their conquered territory. By the close of the year the British and French had fought their way to the dominating positions all the way from Rheims to the plain bordering the English Channel. They now hold the crests of the ridges, formerly in the possession of the Germans, and have the terrain occupied by their enemy under direct observation and fire.

But the Allied successes have netted far less than they should. The entire strategy of the year was upset by an event which had not been anticipated. Had they been able to adhere to the plan of a ring of steel encircling the Central Powers, they could have applied such concentric pressure that the Germans, unable to apply their favorite device of rushing reinforcements from one threatened point to another, must have been squeezed into submission. The Russian revolution put an end to this hope. Had the leaders of the revolution been possessed of a sufficiently broad view and a great enough genius for leadership, the Allied cause would have been the undoubted gainer by the overthrow of the Russian autocracy. As events proved, however, the Russian nation was converted into an undisciplined mob and the Allied chain was broken.

The Russian debacle enabled the Central Powers to throw their whole strength against the west. First, both men and guns were sent to oppose the British and we saw a gradual diminution in the preponderance of strength which the latter had possessed over their enemy. Then came the concentration against the Italian armies, and their repulse to the line of the Piave, ending a most promising prospect for a decision against Austria in 1918.

There is a generally accepted and well founded belief that the early months of 1918 will witness a supreme effort on the part of Germany to win a decision. Her chances will never be better. Tho the Allies will still have a greater strength in guns, the

man power of the opposing armies will be approximately equal. The United States will be unable materially to aid the Allies before the latter part of 1918 at the earliest, and probably not before 1919. The coming year offers to Germany her last opportunity to break the power of her enemies and win before the United States can throw her strength into the scale. That she will avail herself of it is to be taken for granted, since the tentative proposals for a general peace which were offered at the conference with the Russians have been coldly received at all the Allied capitals.

The events of December have been more or less indecisive. What advantages were gained by either side fell mostly to the Central Powers. The British at Cambrai were forced to give up a large part of their gains of last month. The Italians suffered further reverses in their defense of the northern line protecting the rear of the Piave positions. The invaders have now covered most of the distance to the plains. Tho the distance remaining to be covered is relatively short the terrain is such that it should be more easily defended than most of the country in which the fighting has been taking place. The danger is far from past, however.

As a step toward a more successful prosecution of the war, the President upon the opening of the Congress recommended a declaration of war upon Austria-Hungary. This action was formally taken by the Congress on Dec 7. There was strong agitation for a similar declaration directed against Germany's other allies, but it was decided to accept the President's view that they were merely tools of Germany, against which we cherished no resentment and with which we were not liable to come in contact.

[Digested from miscellaneous sources; covering the month of January, '18.]

January has witnessed few strictly military happenings. The outstanding events connected with the world war have rather been political in their nature, bearing on the outlook for peace. Particularly has this been true of the Central Powers. President Wilson, in an address to Congress on Jan 8, restated the war aims and peace terms of the United States in considerable detail. On the 5th Premier Lloyd George had made a similar statement in an address before the convention of labor delegates assembled in London. After waiting until Jan 24, Chancellor von Hertling before the Reichstag Main Committee, and Count Czernin before the Austrian delegation of the Reichsrat, replied to these statements on behalf of their respective governments. Both considered seriatim the proposals contained in President Wilson's address. Tho there was a seeming agreement on the part of both with many of the American specifications, the divergence on the more important items was so great that it is apparent no immediate agreement can be anticipated. Such being the case no good can be served by considering the terms here. The German and Austrian answers to the President's proposals are in great contrast. Count Czernin manifests an evident desire to agree as closely as possible, and invites the United States to enter into a conference with a view to clearing up the points of disagreement. The German Chancellor, on the other hand, affects an attitude of haughty indifference toward the whole matter.

There have been grave social and political convulsions in both Austria-Hungary and Germany. They are due to a general desire for an early conclusion of peace, and specifically, among other things, to dissatisfaction with the peace negotiations at Brest-Litovsk, to the food situation, to the suspension of the right of public meetings, and to an insistence upon the democratization of the state institutions. The Socialist agitation in both countries is assuming enormous proportions. Beginning with Jan 18 strikes and disorders rapidly spread over most of Austria and Hungary, the munition factories being especially involved. A similar state of affairs soon spread to Germany. Such essential industries as the Krupp works at Essen, the Vulcan works at Hamburg, the munition factories of Berlin, the Kiel shipyards, and the Westphalian mines were seriously affected. In most cases they were forced to close down altogether. The Austrian strikes were settled before the end of the month. Those in Germany seemed about to end as the month closed, but only thru the use of military force, the army having intervened to put an end to the situation. Tho the disturbances seemed stopped, the manner of their stopping is not such as to give any surety that they may not be resumed at the earliest favorable opportunity. The conditions which brought them about still exist, and their resumption is something which the Central Powers must constantly guard against in the future. Approximately 2,000,000 laborers were involved altogether.

[Digested from miscellaneous sources; covering the month of Feb, '18.]

It begins to appear that the long-expected elimination of the Russians from the war has finally come. Ukrainia has signed a treaty of peace with the Central Powers, and that portion of the former Russian Empire is definitely removed from the ranks of the Allies. In fact, German and Austrian troops are assisting the Ukrainians in their struggle with the Bolsheviki. Farther north, in what may now be regarded as Russia proper, the Germans have resumed active operations, but they are practically unopposed and their new invasion may be considered largely in the light of a threat to bring the Bolsheviki to terms quickly. Unless there is an immediate overthrow of the controlling power in Russia, it can be but a question of a very short time until a peace is signed. Rumania, too, can now do nothing but accept the best possible terms and lay down her arms.

That the eastern theater might be eliminated from consideration in so far as its having any material bearing on future operations was concerned has long been the expressed opinion of the world at large. The

EUROPEAN WAR—Continued

actual occurrence has, therefore, been already discounted. As conditions were before this latest development, all that the Central Powers needed to do on the eastern front was to maintain a frontier guard as a precaution against any untoward event. This they must still do, tho the strength of the force left there may now be reduced to a minimum.

There have been few events of military importance during the month, aside from the German invasion of Russia. This operation itself is rather political than military in its conception, having been instituted to bring the Bolsheviki to a realization of their impotence and to hasten the consummation of peace.

[Digested from miscellaneous sources; covering the months of Mar, '18.]

Overshadowing all the news of the month, and indeed the news of many months, looms the final launching of the great offensive for which the Germans have been openly preparing and of which they have been as openly boasting. In the early part of March came the anticipated conclusion of peace between the Central Powers and Russia, quickly followed by the elimination of Rumania, also, from the ranks of the Allies. These events had been so thoroly discounted that they created scarcely a ripple. Then began the German drive, concerning which all authorities agree with the Kaiser when he said "We are at the decisive moment of the war." It is generally believed that the present battle is the Gettysburg of the Great War. Victory one way or the other does not mean the immediate ending of the war in favor of the victor, but it will in all probability indicate what the ultimate outcome must be.

The stroke fell on the British line extending southward from the Scarpe River for a length of about fifty miles. The Germans gained a great amount of territory, having advanced nearly forty miles at the southern end of the section attacked. Here, however, they were checked, and as the month came to an end they were preparing their forces for a resumption of their effort. At the close of this initial stage of the battle, General von Ludendorff, widely held to be the brains of the German General Staff, stated that the "victory has been won," adding however, "but nobody can see what will result from it." In this latter statement the General will find many supporters, but there exists a strong doubt that the Germans have yet won a victory. A mere gain of territory does not, under present conditions, give the Germans the semblance of a victory. The undoubted purpose of the German drive was to break the British line, not merely to push it back. Unless that end can be accomplished the entire movement must be considered a costly failure. Another deadlock, even at the end of an advance considerably greater than that already achieved, will mean that the Germans have lost this new battle of the Somme.

A curious innovation with which the Germans accompanied their blow is a new long range gun capable of firing at distances vastly greater than anything heretofore known. When the news first came that Paris was being bombarded by guns, it was received with incredulity, for the German lines were over sixty miles away and there was no gun known that could shoot more than half that distance. The facts were confirmed by later reports, however, and the guns were finally located in the Forest of St. Gobain, at a distance of 76 miles. Nothing definite is, of course, known about the guns, but unexploded projectiles have been recovered. They are of 8.8 inch caliber and 20 inches long, weighing 200 pounds, but containing less than 20 pounds of explosive. No military purpose for this bombardment is evident. If the intention was to strike terror to the hearts of the Parisians, the attempt was an utter failure, curiosity apparently being the dominant feeling in the city. The casualties have been quite small, most of what have occurred being the result of one of the shells striking a church in the outskirts of Paris at a time when it was full of worshippers on Palm Sunday.

One good effect of the German offensive has been that the imminent danger has finally induced the Allies to accept the principle of one central authority for all the forces on the western front. It was officially announced on Mar 29 that General Ferdinand Foch, Chief of the French General Staff and the French military member of the Inter-Ally Supreme War Council at Versailles, had been named as Generalissimo of all the allied forces in the western theater of war. It is not yet known whether General Foch's authority extends to the Italian theater. In any event he will now be in supreme command of the French, British, American, Belgian and Portuguese troops on the western front. This unity of command is a principle for which the American authorities have been striving ever since our entry into the war.

[Digested from Miscellaneous Sources; covering the month of Apr, '18]

For another month the attention of the world has been riveted upon the happenings on the western front to the practical exclusion of all other news. By the first part of April the great German thrust towards Amiens had come to a stand-still. No sooner had it become thoroly evident that such was the case than a similar blow on a smaller scale was struck against the lines in the vicinity of Armentières and Ypres, well to the north of the former battle area.

During the first week of the German offensive that started on March 21, amazingly rapid progress was secured. This we now know was to a large extent due to the failure of General Gough's Fifth Army to hold the line opposite St. Quentin, thus opening a dangerous gap on his left. Aided by the rapid extension of the French left, the British quickly recovered from the predicament in which they found themselves and checked the German advance. During the second week of the offensive the principal attack was directed against Amiens, but the

Allies soon brought this to a stop. Meeting with but slight success in their attempts to drive forward at the point of their salient, the assailants devoted their attention to an endeavor to widen it by operating at its base. Their heavv attacks at Arras, however, profited them nothing, while their casualties were frightful.

Field Marshal von Hindenburg now resorted to the strategy which he had used with such success on the eastern front, and which has been given the name of "Hindenburg's castle" by the Germans, from its resemblance to the "castle" move in chess. This consists of a rapid movement of troops behind the line and a sudden blow at an entirely new point some distance to the flank of the former area of operations.

Like the first offensive, this new stroke met with considerable success at first, but like it, too, the advance quickly became less and less rapid, until by the end of the month it had practically stopped. It was aimed at the important supply centers of Hazebrouck and Ypres, as the greater blow had been directed at the other base of Amiens, but was no more successful in attaining its goal.

Tho there is at present a partial lull in the fighting, it is not to be considered that this is anything more than a temporary condition. The Germans will without doubt attack again and again as the year wears on, in an attempt to gain a decision. Thus far the results of the German offensives are far from discouraging. The loss of French territory and the heavy casualties among the allied troops are regrettable, but the German gains have been very expensive to them in man-power, much more so than to th defenders. No mere gain of territory can repay the Germans for their losses, nor can it be accounted a victory. The German purpose is to so severely handle the British army as to break its power of resistance. So far they have failed signally to even approach this aim. The British morale and fighting power seem to be unimpaired. All that the Germans have accomplished is to trade men for territory, and for territory that is of no particular value to them; which in fact means little more than a further extension of their lines. Unless the armies of their enemies can be forced into submission, their offensive is a costly failure.

For months we have been hearing vague rumors that peace negotiations, at least semi-official in character, were under consideration, if not actually in progress. It has been impossible to secure any confirmation of this, however, until recently. It now appears that as lately as March of this year, and at intervals during the preceding eight or nine months, there have been conferences between representatives of France and Austria. It has also been stated that British representatives have likewise been conferring with Austrian officials. Nothing has come of these attempts to arrive at an understanding, but it is of interest and significance that the attempts have been made.

Closely following the disclosure of the fact that these conferences had been held came a still more astounding revelation. This was to the effect that Emperor Charles of Austria, in a letter to his brother-in-law, Prince Sixtus of Bourbon, had requested the latter to sound the governments of France and Great Britain as to terms of peace. As an earnest of his good faith Emperor Charles advanced some of his own ideas, conceding many of the points which the Allies have announced their unswerving intention to demand. The publication of the letter brought forth many comments in the German and Austrian press, mostly in the nature of explanations or denials. Charles apparently felt it necessary to take cognizance of the commotion caused by the publicity given the letter and telegraphed Kaiser Wilhelm denying that he had recognized France's claim to Alsace-Lorraine. He did not, however, repudiate the letter. One direct result of this affair has been the resignation of the Austro-Hungarian Foreign Minister, Count Czernin. There has even been talk of the abdication of the Emperor, but there appears to be no foundation for this.

Another confidential document that has just come to light has created a vast amount of discussion during the month. This is the secret memorandum of Prince Lichnowsky, who was the German Ambassador in London from 1912 until the beginning of the war. Accused of having unforgivably blundered in his manner of handling the situation in Great Britain, he was made the scapegoat for the turn of events in the first days of the war. To clear his memory he wrote a "Memorandum of My London Mission" for preservation in the archives of his family. This eventually came out and its publication definitely clears England of the allegation that the responsibility for the world war rests upon her. Not only that, but the blame is irrevocably fastened upon Germany, which is shown to have insisted upon war when Austria would have compromised. The document is rather a confirmation of what most of the world has believed all along than a revelation of new facts, except as to details. It has, however, caused a great stir in Germany, where the papers are now printing the facts of the case for the first time.

[Digested from Miscellaneous Sources; covering the month of May, '18.]

For the third month in succession, May has witnessed the inauguration of a new German offensive. It would probably be more accurate to say a new manifestation of the same offensive, since all the widely separated blows must be considered as really forming a part of the main movement, which has not been lost sight of for a moment.

The fundamental idea underlying all the German strategy for the year has been the gaining of a decision before the United States could become a determining factor in the war. To do this it was necessary that the Allied line should be broken in order that each part might be fallen upon separately and crushed. The

EUROPEAN WAR—Continued

easiest way to accomplish this end was to thrust a wedge forward to the sea, effectually blocking communication between the two wings. The first German drive went a long way toward attaining this, but the salient finally became too sharp for safety and ease of operation. Herculean efforts to broaden the point of the wedge by attacking along the sides, especially at Bucquoy and Arras were unsuccessful. Accordingly another wedge was driven in at Armentières in the evident hope that the British line might be so deeply indented that it would be forced to fall back from its advanced positions to rectify the alignment. This, too, fell short of accomplishment and we now see the third phase of the operation, in another application of the "Hindenburg castle."

The southern face of the Amiens salient between Montdidier and Noyon had shown itself capable of resisting the powerful attacks that were directed against it in the first offensive. If the salient were to be broadened on this side, therefore, it seemed necessary to select some other section for the purpose. This was found farther to the east, between Soissons and Rheims. The Allied line here was so strong that it would probably be but weakly held, and it might be possible to break thru by an overwhelming attack before the Allied command could bring up adequate supports. Once the line was pierced, the attack could swing to the west, outflanking the position which had previously resisted frontal assaults, and thus obtaining the requisite width of front before Amiens for a renewal of the original drive on a large scale. Such appears to be the general conception of the idea underlying the latest German operations.

The attack met with phenomenal success, pushing rapidly south to the Marne. At the end of May the change of direction toward the west was just showing signs of developing. The success or failure of the movement as a whole cannot yet, therefore, be foreseen. It seems not improbable that the Germans had not originally intended to push quite so far to the south; that they were drawn somewhat out of their predetermined path by the ease with which they were advancing. If their plan was indeed the one outlined above, they did not need to advance to the Marne to gain their end. The main topographic lanes toward the west were in their hands before they had gone so far. It is true, however, that they have an excellent protection for their flank in the Marne River, should they make an extensive lateral movement. The coming month will show how much they can profit by their initial successes after the Allied reserves come upon the scene.

In no other theater of the world war were there operations of major importance during May. In Italy there are signs that the lethargy of the winter is about over, but the much talked of Austrian offensive has not yet developed. Austria is, indeed, having troubles at home which may delay her operations still farther. The internal unrest is becoming greater as time goes on. Indications are not lacking that many elements of her heterogeneous population are but awaiting a favorable opportunity to break into active rebellion. It has been found necessary to divide Bohemia into twelve districts, giving the German part of the population additional power, to split the Czech power, and to declare martial law.

[Digested from miscellaneous sources; covering the month of June, '18.]

The outstanding military events of the month of June were the definite halting of the German offensive northeast of Paris and the launching of the long expected, but short lived, Austrian offensive in Italy. At the close of May the German drive southward to the Marne was still in full swing, having just started to change its direction toward the west. For the first few days of June the invaders continued to gain, but the French reserves, assisted by some contingents of Americans, then came upon the scene. The Germans were quickly stopped and even forced back in some places. A shift of the main German pressure northward to the Oise region met with some preliminary success, but it was not long before this, too, was checked. The last part of the month saw no major operations. The Germans appear to be collecting their strength for another mighty attempt to secure a decision this year. Prisoners report that this last great drive is to take place in August.

The offensive against the Italians has been anticipated and discussed for some time. The Italian General Staff had in mind two points in their lines where offensives might be expected. Which one of the two would be the actual scene of the blow was thought to be dependent upon the course of events in France. If the German offensive in Picardy broke thru sufficiently to isolate the troops north of the Somme or forced the French south to the defenses of Paris, it was believed that the Austrians, probably with German assistance, would attack down the Giudicaria Valley, west of Lago di Garda. This drive would be directed against the metallurgical center of Italy with the object of reaching a decision—political as well as military—as soon as possible, forcing Italy out of the war and gaining the approaches to the back door of France along the Mediterranean coast.

If the Germans were prevented from gaining their objectives in France, it was thought that the Austrians, with no aid from their allies, would devote their energies to a continuation of the offensive of last year. This blow would come from the north and east—along the line from the Sette Comuni east to the Piave and thence to the Adriatic. As the Germans did not gain the requisite success in Picardy, the Italian staff based their plans upon the offensive in the east. The event proved the accuracy of their forecast and the Austrians were defeated and driven back almost before they had well started.

Much attention has been devoted during the past month to the question of intervention in Russia by the Allies. It has now been recognized in principle by all of the Allied nations that some action of this sort should be taken. The details of just what form such action should take has not yet been settled, however. The hold which the Czechoslovak force, composed of ex-soldiers of the Austrian army, now has on the Siberian railroad, coupled with the present control of the

Arctic coast by the Allies, renders this a most opportune time for the initiation of armed intervention. It is feared, however, that such action by the Allies would throw the Bolsheviki into the arms of the Germans. On the other hand, it is contended by many that anything less than armed intervention will be totally ineffective against the intrigues of the Central Powers. It is to be hoped that some effective solution may be arrived at shortly. The desirability of re-establishing the eastern front is so axiomatic as not to require pointing out.

It has been given out that over one million American soldiers have now sailed for France. The sailings from May, 1917, to include June, 1918, were as follows:

1917—May, 1718; June, 12,261; July, 12,988; Aug, 18,323; Sept, 32,523; Oct, 32,259; Nov, 23,016; Dec, 48,840.

1918—Jan, 48,776; Feb, 48,027; Mar, 83,811; Apr, 117,212; May, 244,345; June, 276,372.

Aggregate—1,019,115.

[Digested from Miscellaneous Sources; covering the month of July, '18.]

For the first time this year the Allies have launched an offensive themselves instead of remaining upon the defensive and awaiting the blows of the enemy. The movement started as a counter to the German drive across the Marne. Altho the situation of Rheims was not yet acutely dangerous, it was evident that the defense south of the city must be strengthened or some other means taken to stop the Germans. General Foch is essentially an offensive fighter, so the application of counter-offensive measures would naturally appeal to him. It is known that the Allied leader has been preparing for the assumption of the offensive whenever a favorable opportunity presented itself. Here was a chance to both seize the initiative and bring the German threat against Rheims to a halt. With characteristic quickness of decision the opportunity was made the most of, and the effort was crowned with success.

The Germans fell back across the Marne on the third day of the offensive. The first of Foch's aims had been secured, but the movement was now turned into an attempt to flatten out the entire Marne salient. By the end of the month the Germans had fallen back fourteen miles at the point of greatest retrogression. Heavy movements of troops and material to the north and the burning of villages and supply depots behind the German lines indicate that they have no intention of trying to stay the victorious Allies yet. The coming month will undoubtedly see them behind the Vesle River, or even farther north behind the Aisne. At the end of the third day the Allies reported the capture of 20,000 prisoners and 400 guns. Thereafter the captures were not so heavy, but by the end of the month another 10,000 men and 100 guns had been added to the totals.

July was a quiet month in the theaters outside of France. In Albania the Italians, assisted by French troops, pushed northward for from fifteen to twenty miles. There the movement halted and has not been renewed. It could, in any event, accomplish no great ends unless taken up clear across the Macedonian front, an operation that would involve the employment of so many men and so much material as to be beyond the realms of possibility in the present condition of the Allies.

So far the question of Allied operations in Russia has not been settled. It appears, however, that an agreement has been reached as to the form that the intervention should take. The details have not yet been made public, but the intention now appears to be to support the Czechoslav force in Siberia by a landing at Vladivostok to protect their rear. In the meantime the Allied force at Kola on the Murman coast has been reinforced and has advanced slightly to the south, taking up a position at Kem to give an advanced line of defense.

The German submarine campaign continues to meet with less and less success. The sinkings of allied and neutral merchant tonnage were smaller during June than in any month since September, 1916. In July an even smaller tonnage was sunk. On the other hand the American shipbuilding effort is beginning to show results. In the year ending June 30, 1918, there were built in the United States sea-going steel steamers with a gross tonnage of 1,034,604, and 157 sea-going wooden vessels of 213,088 tons. More than half of these were completed in the last four months of the fiscal year. During July there were launched 123 new ships of 631,944 tons. Great Britain has added about 1,400,000 tons to her merchant marine during the past year. The aerial supremacy of the Allied Powers is growing constantly more pronounced. In a statement given out on July 13, London announced that British air forces had brought down 4102 enemy planes during the past year, as against a loss on their part of 1121 machines.

[Digested from Miscellaneous Sources; covering the month of Aug, '18.]

"The Germans have twice lost the war at the Marne. In 1914 they lost the chance to win the war in the first campaign. In 1918 they lost the chance to win it in any campaign; that is to win it by a decisive military triumph." It has been generally held by the military opinion of the world that the Germans must win this year if they are to win at all. When General Foch threw the Prussian Crown Prince upon the defensive by his smashing blows against the Marne salient in July, he accomplished much more than the mere stopping of Germany's latest offensive—he so disrupted the plans of the enemy by forcing the shifting of reserves that the entire Germany Army was compelled to surrender its aggressive attitude.

The elimination of the Marne salient was completed early in August when the French and Americans reached the line of the Vesle. His brilliant success here gained for General Foch the title of Marshal of France and the acclaim of the entire world outside the Central Empires. Another man might well have felt that he had accomplished all that could at once be expected of him, in arresting and throwing back the Germans at the point they had selected for decisive action. But Marshal Foch was of another mind. Hav-

EUROPEAN WAR—Continued

ing seized the initiative he had no intention of surrendering it unnecessarily.

By forcing the Germans back to the Vesle, the main line of communication with the Champagne—the double-tracked railroad along the Marne—had been freed. But the Germans were dangerously close to another important supply line—the Paris-Amiens railroad, which was essential to the Allies' communications south from the Channel ports. The point of the German salient toward Amiens was therefore selected for the next blow. Scarcely pausing after gaining the line from Soissons to Rheims, the Allies struck with staggering effect in the new theater. The movement was initiated on a relatively short front, but as the enemy's positions were penetrated the attack was continually broadened, until by the end of the month it extended from the Scarpe to the Aisne, about 57 miles. The Germans have already been forced back almost to the old Hindenburg line along the whole front, while at the southern end the French are on that line and on the north the British are across it. It is practically certain that the Germans will make a determined effort to halt the Allied advance in their old positions. Opinions differ as to the chances they have of success in such an endeavor. The next month alone can tell the tale.

There can be little doubt that as matters stand today the German army faces inevitable and total defeat. It had been expected that the Allies would be hard pushed to withstand the German blows of 1918. That Marshal Foch would be able to seize the initiative this early in the year and maintain it so consistently would have been thought almost beyond the realms of possibility at the beginning of the year. The effect of the Allied success upon the German morale has been most gratifying to the Allies. Papers thruout Germany admit that German arms have suffered the most serious reverse of the war, and the probability of ultimate defeat seems to have finally reached the German mind.

The losses suffered by the Germans have been most severe. It is conservatively estimated that they have reached a total of approximately 1,200,000 since the beginning of the offensive on July 15. Some 60 per cent of these casualties are, of course, temporary, but the killed, captured and incapacitated must total nearly 500,000. On the other hand the losses of the Allies are reported to have been relatively small when compared to those of the enemy, while they have been really very slight measured in the results accomplished. Moreover these losses are being more than made good by the accretions in strength from the United States, while many of those suffered by Germany are irreplaceable.

During August came the announcement of the formation of the First American Field Army, command of which is being retained by General Pershing in addition to his position as commander of the entire expeditionary force. The Americans have been assigned a definite part of the western front, including most of the line in eastern France and in the part of Germany held by the Allies. There has been practically no action on this section of the line.

It is not only in France that the Central Powers are in difficulty. Their peace in the east is not proving to be as wholly profitable as they had hoped, and the re-establishment of the eastern front is no longer among the impossibilities. It is yet too early to foretell just what may happen. It may well be, however, that the Germans will find it necessary to dispatch troops to the east at the very time they can least well spare them.

[Digested from Miscellaneous Sources; covering the month of Sept, '18.]

The rising tide of Allied successes, which began in July and continued during August, has remained at the flood thruout September. The Germans and their allies have suffered reverse after reverse. On the western front Marshal Foch has well lived up to his reputation as an aggressive offensive fighter. He has given the enemy no respite. At no time during the month have the Germans been free to carry out the dispositions of their troops entirely as they might see fit. There has been constant pressure against some part of the line. At least one considerable section of the front, and generally two or three, have been subjected to attack all of the time, the action taking place now here and now there. As a result of the constant shifting of the points of application of the Allied strokes, the Germans have been forced to move their reserves about in a bewildering fashion. The month closed with the Allies attacking strongly against practically the whole front except the section in the Vosges mountains. The uniform success which has attended the Allies' efforts has been truly remarkable. At the end of September the only points between the Vosges and Dixmude where the Germans had not been pushed behind their strongly fortified 1917 lines were a short section north of Verdun, the fronts south and west of Laon, and a small, unimportant area to the southeast of St. Quentin. These results are especially encouraging when we reflect that at the beginning of the year the most that was expected was that the Allies would be able to bear up under the German blows without the loss of too much territory.

Great as have been the results achieved in France and Belgium, the blows against the Central Powers in other theaters during September may prove to have even more effect upon their speedy overthrow. The possibility that Germany will be able to profit greatly by the Russian debacle is steadily growing more remote. The power of the Bolsheviki seems to be almost at an end, while the gradual closing in of the Allied expeditionary forces brings closer the day when the Germans will be forced to spare some of their sorely needed men to re-establish a line of defense in the east. In Palestine, General Allenby has delivered a staggering blow to Germany's most southerly ally by the almost total destruction of the Turkish army that has been opposing him. As a result of this success, there is no apparent reason why Allenby may not be able to move northward to Aleppo, unless the Turks display an unusual rapidity in the organization of a new force to bar the

way. Should it prove practicable to seize Aleppo, the supply line of the Turkish troops in Mesopotamia will be interrupted and they will be forced to abandon that country as well.

But it is the collapse of Bulgaria that opens up the greatest prospect of trouble to her former allies. The signing of the armistice that took Bulgaria out of the war marked the rupture of the first link in the chain that Germany had forged across Europe. Whatever may be the outcome of the matter, this is a serious blow to the Central Powers. Whether or not it will proce disastrous depends upon how thoroly the terms of the armistice are carried into execution. If the Allies succeed in occupying all of Serbia and Bulgaria and establishing a new line along the Danube, Turkey must shortly follow the lead of Bulgaria in making peace. Cut off from communication with Germany, she could not long hold out against the Allies. Moreover there is no doubt that Rumania would waste little time in re-entering the war if she were definitely assured of supplies and support. Her people have not ceased to smart under the onerous peace they were forced to conclude thru the defection of Russia, and would be prompt to take advantage of any favorable opportunity to resume the struggle.

It is highly probable that the Central Powers will attempt to hold enough of Serbia and Bulgaria to protect the railroad to Constantinople. In fact their troops were reported along the railroad and in Sofia before the armistice was concluded. In any case, however, whether the Austro-Germans hold the line of the railroad or a new front is established on Austria's southern frontier, a great many men will be required. It is a question where the Central Powers are to find them without seriously weakening some other essential front. It is known that they have about six divisions in Rumania and thirty in Russia. But these are not enough. Moreover, there is a strong probability that more troops rather than less will be needed in Russia before long. The problem before the German command is certainly not an easy one.

The "drive" for a general peace, which has been looked for this winter, was started in September by a proposal from Austria-Hungary suggesting that all the belligerent powers send delegates to some neutral point for a non-binding discussion of peace terms. At the same time Germany made an offer of peace to Belgium, affecting that country alone. It does not appear necessary to enter into any discussion of the details of these maneuvers, as both were immediately and unconditionally rejected.

[Digested from miscellaneous sources; covering the month of Oct, '18.]

The great offensive begun in the last days of September had spread until it included practically the whole front from Verdun to the North Sea. This offensive was continued with unremitting vigor during the entire month of October. The story of the military operations of the month is one of relentless and powerful pressure, shifting from one sector to another, never suspended except for the brief periods necessary to readjust as the German lines yielded under the sledge-hammer blows.

Early in October, under heavy pressure on the Ypres front and between Cambrai and St. Quentin, the German lines yielded at both points, and the connecting front from Armentières to Lens was abandoned as a necessary consequence of the Allied advance on both sides. By the close of the month, the German defensive line had been swept back to Ghent and the line of the Lys, and thence to the line of the Scheldt southward. A large sector of Belgium had been redeemed, and much more important, the U-boat base at Zeebrugge had fallen into the hands of the Allies, together with the whole of the Belgian coast.

South of St. Quentin and eastward to the Argonne, a similar withdrawal had been forced. The Chemin des Dames ridge was recaptured and the German line forced back to the Suippe.

The result of these withdrawals by the Germans was to regain control of a large stretch of territory which had been in German possession since the beginning of the war, and including such important places as Lille, Valenciennes, Roulers, Tournai, Cambrai, and St. Quentin. Laon, La Fère, and the massif of St. Gobain had fallen into the hands of the Allies. This region included the position from which the long-range bombardment of Paris had been conducted. The withdrawals on the Rheims front had finally freed that city from further menace and destruction.

In the Argonne and eastward to the Meuse, the American attack met with most determined resistance, because at this point the yielding of ground by the Germans would imperil the withdrawal of the forces further west. Advances were followed by violent counter-attacks for the purpose of regaining the ground won, and the result of the operations for the month was a limited gain to the Grand Pré-Vouziers line. But this pressure was at a vital point and the defense had cost heavily in losses, and the gain of ground was vital if limited.

The yielding of ground by the Germans was forced by the heavy and relentless pressure of the Allied attacks, but the withdrawal bears evidence of being contemplated, and it certainly was conducted with great skill.

The toll of prisoners was in the aggregate heavy, but occurred thru repeated small captures, and at no time did the Allied attack develop a situation where any large part of the German Army was jeopardized. The Allied capture of guns mounted up in numbers, but not to an extent that could not in large part be accounted for as the abandonment of unserviceable or worn artillery that would be left behind in a retreat where transportation was scant and the roads encumbered with other material.

As the end of the month was reached, the line appeared to be stiffening up to the point of stabilization. Along the Lys and the Scheldt, in the Mormal Forest, in the Serre-Oise angle, along the Suippe and east to the Meuse, the Germans appeared to have reached a general line where they might hope for a respite from the continuous withdrawal. An indi-

EUROPEAN WAR—Continued

cation of the military tension in Germany was Gen. Ludendorff's resignation Oct 27.

Of tremendous import as were the military operations during October, they were overshadowed in the public mind by the political developments of the month. Bulgaria had formally agreed to the terms of the armistice at the end of September. Turkey, broken by the defeats in Palestine and Mesopotamia, and long showing signs of distress, yielded on Oct 31. Austria-Hungary, tortured by internal difficulties and harassed by a new offensive on the Italian front, is apparently on the verge of yielding to the Allied terms.

But of far greater significance are the indications of military and political distress on the part of Germany. The cry for peace is become pressing. Early in October came reports of disturbances. Von Hertling as chancellor was replaced by Prince Maximilian of Baden, who immediately addressed an appeal to President Wilson for peace on the basis of the President's well-known "points." To this the President replied on Oct 8, demanding to know what the German Chancellor meant, refusing to consider an armistice while German troops were on Allied soil, and asking whether the German Chancellor was speaking merely for the constituted authorities who had so far conducted the war.

To this note Germany replied on Oct 12, claiming to have accepted the President's terms, and to be desirous of agreeing upon the practical details, and further claiming that the government represented the majority of the German Reichstag and the German people.

President Wilson replied on Oct 14, saying that the conditions of the armistice must be left to the military advisers of the Allied governments and of the United States, but that any armistice must provide necessary safeguards concerning the maintenance of the military supremacy of the Allies; indicating that an armistice was impossible while Germany continued the illegal and inhumane practices in which she persisted; calling attention to the practices of the U-boats and the wanton destruction of cities by the German armies; and saying finally that it was indispensable to know with whom the Allied governments were dealing in the negotiations.

The German government replied on Oct 21, asking for an opportunity to arrange details as to evacuation, denying the accusation as to U-boat atrocities and wanton destruction, stating that orders had been given U-boats not to torpedo passenger ships, and seeking to show that the German government was now a government representing the people.

President Wilson replied on Oct 23, saying that the correspondence had been transmitted to the Allied governments, that he had suggested the drawing up of the terms of an armistice, discussing the present form of the German government, and saying finally that the "nations of the world do not and cannot trust the word of those who have hitherto been the masters of German policy," and that if dealing with those persons, the demand must be for surrender instead of negotiations.

To this note the German government replied on Oct 27, calling attention to the changes effected in the German government, and asking proposals for an armistice.

Representatives of the Allied governments began conferences in Paris for the purpose of framing the terms of the armistice, and were continuing their sessions for this purpose as the month closed.

Deserted by her allies, the yielding of Germany and the close of the war seem imminent.

WESTERN THEATER

The success of the British in their late November offensive south of Arras had left them in possession of a three-sided projection to the main line much in the shape of a blunted redan with the capital, or median line, pointing to the northeast toward Cambrai. The principal face, fronting Cambrai from the southwest, extended from Rumilly on the right to Bourlon Wood on the left, a distance of about six miles. The northern flank ran westward from Bourlon some four miles to a point just north of Moeuvres, while the other flank extended southward from Rumilly to Honnecourt, about six miles distant. The heaviest German counterpressure had been exerted from the beginning on the northern portion of the area. It was evident from the strength of the resistance to the British advance after the first days that the Germans had been strongly reinforced, and a counterattack in strength was confidently expected. The British command apparently erred, however, in their estimation of the point where the assault might be expected. As a result they concentrated the bulk of their forces on the northern faces in anticipation of the attack being delivered there.

To a certain extent the British were right in their estimate of what to expect, but the German effort, when it came, proved to be much more ambitious than had been foreseen. The British salient, while it controlled the approaches to Cambrai and threatened that city as long as it was firmly held, had its dangerous features as well as its military advantages. The Germans, of course, appreciated this, and their plan of attack involved simultaneous blows against the flanks of the projecting position while the front was being contained by direct pressure against it. It is evident that if either of the British flanks could be broken thru the center or main front would be exposed to enfilade and reverse attack while unable to make good its retreat on account of the pressure on its front.

The German attack was started at 7:30 on the morning of Nov 30 [1917]. On the northern face it met with very meagre success. It was checked immediately at Bourlon Wood and at Moeuvres, but between these points the attackers penetrated the position for several hundred yards before they were stopped after severe and protracted fighting. Their most important gain in this section was the ridge to the west of Bourlon Wood, giving them command of much of the surrounding territory.

The attack on the southern flank was much more successful. The entire face from Masnières to Vendhuille was assaulted simultaneously. As we have seen, this part of the British line was more weakly held than

the others, but the defenders resisted heroically nevertheless. The lines held along most of the position. Opposite Honnecourt, however, the Germans broke thru in strength over a wide front. Once the main position had been passed, the assailants quickly brushed aside the opposition that was offered them. In less than an hour they had pushed westward to the village of Villers-Guislain, about two miles from their starting point. From here they swung off to the right and seized the villages of Gonnelieu to the north and Gouzeaucourt to the northwest. With the capture of Gouzeaucourt the Germans were astride the railroad which was one of the arteries of supply for the British forces. So rapid had been their advance that they appeared on the railroad before their presence in the vicinity was suspected and drove out the American engineers who were operating the line for the transportation of munitions to the fighting line.

The whole British position was now seriously compromised. At this stage, however, reinforcements arrived and began a counterattack. The Germans had overrun a portion of the British artillery zone and had captured a number of the pieces. The remaining guns in the section were close up to the action and advantageously placed to support the counterattack, while the German artillery had been left so far behind that it could afford little aid to its infantry. The struggle raged until late in the afternoon. Finally the Germans were driven out of Gouzeaucourt and pushed back of a slight eminence just west of Villers-Guislain. The threatened break in the British line had been stopped and the danger averted.

For the next three days the Germans assaulted vigorously but without making any gains which materially altered the situation. On Dec 2 the British abandoned their position east of the Scheldt, withdrawing to the stronger line on the west bank. Even with this withdrawal the situation of the British was precarious in the extreme. The salient had been so narrowed that the German guns on the flanks could easily sweep it from side to side. The lines were holding, but the German concentrations were very heavy and another such break as the last one might well mean the loss of all the thousands of men garrisoning the salient. It was accordingly decided to evacuate a further large part of the recently conquered territory. The movement was carried out on the night of Dec 4 without molestation. About half of the recent gains were given up. The new line taken up extended southeastward from Moeuvres along the ridge west of Graincourt to Marcoing, and thence southwestward to a point east of Gouzeaucourt.

These developments constitute a distinct reverse to the British, tho they are still the gainers by the operation as a whole. They occupy a considerable and important portion of the Hindenburg line, and their new positions are much stronger than the old. In the matter of relative casualties their advantage is still greater. The British captured many more prisoners in their offensive than did the Germans in the counterattack, while the losses to the assailants in the original attack were markedly less than those suffered by the Germans when they assumed the offensive. It is greatly to be regretted, however, that the British were unable to retain their original gains. From the heights which they first seized in the vicinity of Bourlon Wood, Cambrai with all of its approaches was under direct observation and the valley of the Scheldt was completely dominated. This advantage has now been lost. With the vastly greater number of German troops now available for duty on the western front due to the Russian collapse, it is doubtful if the abandoned positions can be retaken without a prohibitive cost in men.

The British retirement was carried out in fully as masterly a manner as the original offensive. All the guns and munitions were safely taken to the rear before the infantry evacuation was commenced. Everything that could be of any military advantage to the Germans was destroyed. The whole movement was conducted with such secrecy that the Germans did not discover for hours what had happened. Their bombardment of the advanced position continued well into the 5th before they realized that they were shelling vacant trenches, and sent patrols forward to investigate. It was the next afternoon before the new positions of the British were definitely located. The Germans launched a number of powerful massed attacks and suffered several thousand casualties before they became convinced that they had reached the real line of defense, to penetrate which they must pause and make the usual preparations for an offensive blow.

With the cessation of the heavy German attacks after the British retirement the important operations on the British front came to an end. On Dec 12, Bavarian troops attacked in dense masses after a powerful artillery preparation at the bend in the lines between Bullecourt and Quéant. The assailants gained about 500 yards of trench in a small salient but were repulsed elsewhere. Attacks in the vicinity of Polderhoek and Polygon Wood in the Ypres sector also yielded slight gains but nothing of importance, only small sections of the British lines being secured.

At daylight on the morning of the 30th the Germans made powerful local attacks on the Welsh Ridge positions south of Cambrai on a front of about two miles. They were repulsed in the center but gained on the right, to the north of La Vacquerie, and on the left, to the south of Marcoing. The British counterattacks led to heavy fighting which lasted thruout the 31st. At the close the British were in possession of their former lines. Apart from these operations nothing occurred except artillery duels and raids.

On the French portion of the western front there were no major operations. Following the French stroke north of Verdun in the latter part of November the Germans delivered several half-hearted attacks but accomplished nothing of consequence. Thruout the latter part of the month there was carried on what appeared to be a systematic attempt to feel out the French positions all along the line by raids and small attacks. These activities were especially noticeable in the five localities which appear to offer the most favorable prospects for an offensive; that is, in the vicinity of St. Quentin, in the Champagne east of Rheims,

EUROPEAN WAR—Continued

north of Verdun, in Lorraine near Nancy, and in southern Alsace. Apart from this sudden recrudescence of reconnoitering there have been no indications of any immediate intention on the part of the Germans to undertake the much heralded offensive which has been rendered possible by the Russian collapse and the consequent transfer of troops to the western front. The first heavy fall of snow of the year came on Dec 16 and it is doubtful if the weather conditions for the next month or so will be at all favorable for operations on an extensive scale by either infantry or artillery. It is not improbable that the German reconnaissances have been undertaken for the purpose of getting data on which to base their plan of operations for next spring. It is generally accepted that the German leaders will not fail to take advantage of their present access of strength to endeavor to force a decision before the United States can intervene effectually. If they do not assume the offensive at once it will merely be because they have decided that the prospects of success are better if they postpone their attempt until the more favorable weather of spring.

On no part of the front in France and Belgium were there any major operations during January. Even the artillery activity decreased materially. The clear frosts and dry snows of late December and early January have been succeeded by thawing weather, with fog, rain and wet snow, varied by short periods of freezing temperatures. Under either condition of the weather, the difficulties of supplying and relieving the men in the front lines are so great that a minimum garrison for defensive purposes has apparently been all that either side has regularly maintained in the advanced positions. In a similar way the weather has tended to restrict the artillery fire, not only on account of the difficulty of getting ammunition to the guns, but also because of the low visibility and the consequent trouble in spotting.

In spite of these conditions, so unfavorable to any extensive movements, the front has been far from quiet. Local attacks and raids by both sides have gone on without cessation on all parts of the line from Switzerland to the Channel. In fact these minor enterprises have been more frequent than for a long time past.

Of more ultimate importance than the local actions with which the reports have been filled are the preparations which both the Allies and the Germans have been making for the spring operations, and of which we hear very little. It is certain, however, that everyone is working feverishly to be ready for the events of the next few months, whatever they may be. Apart from our knowledge that such must be the case, the few glimpses we get of activities behind the line point in the same direction. Great numbers of German troops still continue to pass westward thru Berlin. With the constantly decreasing probability that anything is to be feared from the Russians, the eastern front is being stripped to the merest frontier guard, men and guns being transported to the west as rapidly as possible. As a sop to the Brest-Litovsk agreement that there should be no troop movements during the armistice, few formations are being moved intact. The procedure seems to be to grant furloughs in great numbers to men on the eastern front, and then to recall them individually to duty in the west. Here they are assigned to fill gaps in the divisions already on that front, or to new formations which are being organized in rear. This manner of carrying out the reinforcement has the added advantage that the men from the east, many of whom have absorbed more or less of the doctrines which proved the undoing of the Russian forces, are separated and distributed amongst the unaffected western divisions. It is estimated that in this way the Germans will be able to fill all their formations to full strength, and still have available a strategic reserve of approximately 1,000,000 men.

The thinning of the Allies' front line, referred to above, has served to strengthen the formations in rear, upon which the chief reliance must be placed in the event of a future attack. Experience has amply demonstrated that it is the well placed and organized reserve which must be depended upon in the case of a determined offensive. Tho the Allies will probably be weaker than their adversaries in man power on the western front during the coming year, they will still have a preponderance in artillery. The German offensive, which is practically certain to come, is looked forward to by the Allied leaders with no fear as to the outcome. In fact the fear is rather that it will not develop as the powerful thrust that is now so confidently expected. The fundamental aim of the Allied armies is to put as many Germans as possible out of action. A strong German offensive affords the best possible opportunity for accomplishing this. It is possible, and indeed probable, that a certain amount of territory will have to be surrendered, but the greatest confidence is expressed that no serious reverse is to be anticipated.

It must not be forgotten, in considering the probabilities of a German thrust, that their leaders have the alternative of holding the offensive over the heads of the Allied forces, instead of precipitating it at once. Such action presents certain advantageous features. In discussing this phase of the situation, the *Army and Navy Journal* says:

"As between the immediate and the suspended offensive the inducements for the Germans are divided An immediate offensive, delivered at the earliest moment when preparation and weather conditions permit, would strike at the Allies when they were less strong and efficient than they would be later. It would employ the means of Germany before these had been impaired, as they may be impaired, by the growing popular opposition in Germany to the war's continuation. The Entente forces in the west are now at their weakest, because from now on the United States contingent must steadily grow in num-

bers and efficiency. The suspended offensive, on the other hand, has the advantage of avoiding or putting off the serious prospect of strategic failure that attends any attempt for a decision in a theater where every such attempt in nearly four years has failed of its object. At the same time it would have some of the moral effect of an offensive actually under way, for it would keep the Entente armies in a state of apprehension favorable to German peace proposals and harmful to the Allies' own possible offensive plans."

The decision as to when the offensive is to be launched may not rest altogether upon military considerations. The effect of a delay upon Austria, where there are such abundant signs of a desire for an early peace, must be considered. Then, too, an immediate offensive, if unsuccessful, might well have a damaging effect upon the diplomatic efforts of the Germans in Russia. Whenever the offensive may be delivered, the preliminary steps must be identical, to a great extent. Troops must be gathered, artillery placed and material made ready. If all the preparations are made in the beginning a sudden change in plans, involving an assumption of the offensive, can be decided upon and put into effect with little delay. The defending force must be ready for the blow whenever it may fall.

The many trench raids and local actions which took place during January were directly influenced by the expectations of a spring offensive. In addition to the usual reason for these enterprises, that of gaining information of the enemy, there are other factors which enter in. By the distribution of numerous and repeated blows at different points along the line the enemy is kept in a state of expectation, interfering with the normal régime of the winter season. The Germans, moreover, are endeavoring to hold as many as possible of their opponents fixed in position so that they will not be available to strengthen the troops in rear, who must ultimately stop the big offensive if it is to be stopped. It is furthermore important to the Germans to make a demonstration of military vigor, both at home and abroad, in view of their peace negotiations and the internal unrest. The Allies, for their part, wish to give the greatest possible impression of strength over the whole of their front.

In spite of the unfavorable weather conditions aerial activity on the western front has been pronounced. Scarcely a day has passed without mention in the dispatches of a number of fights in the air, doubtless brought about by the endeavors to ascertain what is going on behind the enemy's front. Numerous bombing operations have also been carried out. The Allies are successfully maintaining the supremacy of the air.

British troops have taken over from the French the section of the line west and southwest of St. Quentin. This point where the two armies joined has been considered one of the weak places of the line and a German blow there would not have been a surprise. The junction of the British and French now falls at a more favorable defensive location, while the sector west of St. Quentin, being entirely under one command, should be more easily defended.

The American Expeditionary Force has taken over a section of the front in French Lorraine northwest of Toul. The dispatches give no further indication of the exact location or extent of the American sector. The general statement given out as to the locality places it near St. Mihiel, on the southern face of the German salient which here extends to the Meuse. The length of front taken over will, of course, not be great at the outset, the important thing being that American troops are at last actively taking part in the war.

February has seen a continuance of the same character of activity which distinguished January—an almost constant succession of trench raids, now delivered by one side, then by the other. Particularly has this been the case on the French front from the Oise to Lorraine. The British front seemed to become quieter as the month progressed. The tendency appears to be to increase the size of the raiding parties as time goes on. A number of trench raids were made during the month almost approaching the dignity of a minor attack, when the strength of the forces engaged is considered. It also seems that the artillery is being used to a greater extent than formerly in preparing the way for the raiders. The French, especially, have shown an inclination to engage in these magnified raids, as well as to multiply their number. For this there exists a logical explanation. With appearance of the Americans in the front line, and the extension of the British front near St. Quentin, the French now have available several divisions which have been freed from their former stations. Assuming that the French lines were held with all necessary depth, these divisions are now at the disposal of the higher command for whatever use seems best. Advantage has been taken of this fact to multiply the minor operations where there were formerly no troops to spare.

On only one occasion was there any attempt to hold any of the gains made by the raiders. This was at the Butte de Mesnil in the Champagne on Feb 13. An unusually strong raid in this section gained considerable ground. Part of this was deemed of sufficient importance to retain. This attack was further notable in that two American batteries of heavy sea-coast guns assisted in the operation. Several of the French raids resulted in the capture of many more prisoners than have heretofore attended operations of this character. In the Butte du Mesnil raid on the 13th, 100 prisoners were taken. A raid near Flirey on the 11th resulted in the capture of 250 Germans, while 400 were taken in a raid delivered on the Lorraine front northeast of Nancy on Feb 20.

The American sector in Lorraine has not yet been definitely described, but later despatches permit of a closer approximation to its position than was possible at the close of last month. It appears to be a stretch some five or six miles in length about where the small river Mad crosses the southern face of the St. Mihiel

EUROPEAN WAR—Continued

salient. This portion of the front has long been very quiet. With the advent of the new force there has been a considerable increase in activity on both sides in the way of raids and patrol encounters. The character of the terrain here is not such as to make it very probable that the Germans will soon attempt to prove the mettle of their new antagonists by any serious operations. Under the existing weather conditions, this is probably the least exposed portion of the French front. During the wet season the valley of the Mad is practically a marsh. The poorly drained bottom is dotted with ponds and miniature lakes so there is little opportunity to push forward an attack in force before the coming of dry weather improves the situation.

American troops have appeared at other points along the line besides in the American sector proper during February. In addition to the artillery in the Champagne already referred to, training detachments have been working with the French in the Chemin des Dames region. Here they have been holding short sections of the line interspersed with French forces, while parties made up details from both armies have engaged in patrols and raids.

To offset the appearance of this new contingent in the ranks of the Allies' fighting men, it is reported that Austrian troops have recently been transported to the western theater, where they have been placed in reserve. Should this report prove true, it will mark the first use of any but German forces in the west, if we except the vague reports of the presence of Austrians at the very beginning of the war, and, of course, the Austrian Skodas, which proved so effective in battering down the fortifications barring the way of the German advance.

The artillery exchanges and trench raids in constantly increasing number and strength, which characterized the previous month, continued to be the order of the day on the western front during the first two-thirds of March. Tho all of the contending armies participated in the raiding operations, it appeared that the Germans were taking the initiative in the majority of cases. The growing tendency to increase the strength of the raiding parties and to facilitate their advance by a more effective artillery preparation has been previously commented upon. Practically all that distinguished these magnified raids from true minor attacks was the fact that the raiders returned to their own lines after completing their task, instead of retaining the ground they had overrun.

During the early part of March the Germans, in several instances, definitely passed to the warfare of the local attack, with an evident intention of holding the positions gained. The first of these attempts was made on the French front before Reims. The French lines were heavily shelled on a front of about 16 miles, extending from Lowre, northwest of the city, to the fort of La Pompelle, to the southeast. After the bombardment had reached its maximum intensity on Mar 1, the Germans attacked at a number of points on this line. The first attack was beaten back by the French defensive fire, but a second assault by two battalions, delivered against La Pompelle, succeeded in gaining a lodgment in the outworks of the fort. The positions here were restored by a French counterattack on the next day. Simultaneous attacks delivered farther to the east in the Champagne fared no better. The French in this sector have adopted the policy, in many cases, of withdrawing their troops from the front line prior to the attack, and then assaulting the enemy after he has entered the trenches. The attack before Reims was the nearest approach to major operations attempted on the French front, tho there were numerous raids by both sides and some minor assaults by the Germans.

With the second week of March the center of German activity shifted northward, their principal efforts being made in the vicinity of Houthulst Forest. Early on the morning of Mar 8 they attacked here after a powerful artillery preparation, and established themselves in a portion of the British lines, but were later ejected. The fighting at this point was severe, the Germans clinging tenaciously to the ground they had gained and returning to the attack after they had been thrust out. Other minor enterprises were directed against the British at various points along the line. The heaviest were at Passchendaele, Polderhoek and Armentières. A heavy German assault against the Portuguese troops in the vicinity of Laventie on the night of Mar 11 was repulsed with severe losses to the attackers. Paris reports this action as the most signal victory won by the Portuguese since their entry into the war.

One of the notable features of the despatches during the first part of the month was the great amount of aerial activity chronicled. Not only was this true as regards the front, but also as to enterprises in rear of the lines. The Allied aviators maintained the supremacy of the air over the greater part of the actual fighting front, but were, of course, unable to prevent German raiding squadrons from getting thru the advanced zone and operating in rear. England was probably not attacked any more than usual, but Paris, which has heretofore been remarkably free from the unwelcome attentions of the German airmen, was heavily bombed on several occasions. Some of these attacks produced rather severe casualties. In all cases the raids were made by great numbers of planes operating in several squadrons. Tho the artillery and airplane defenses of Paris succeeded in barring the approach of most of the raiders, a few slipped thru on every occasion and dropped their bombs within the city. It has been suggested that the purpose of the Germans in making these attacks, apparently without military value, is to so work upon the fears of the civilian population as to force the detachment from the front of a large number of battle-planes, thus reducing the superiority in aerial strength which the Allies now possess. With the

German offensive in view, it was at this time particularly important that the Allied ascendency should be reduced, if possible. The Allies, too, have engaged in numerous bombing expeditions behind the enemy lines. They have, however, devoted their energies to the destruction of points of military importance. Tons of bombs have been dropped upon factories, depots, railroads, cantonments and similar centers, the retention of which was of the greatest importance to the Germans.

The much-heralded Spring offensive of the Germans had been so long delayed that it began to be seriously questioned whether or not they were really intending to deliver any blow at all. The continued dry weather and warm, sunshiny days had so dried out the ground that it was entirely feasible to begin active operations on a large scale. As the days passed and there was still no sign of any intention on the part of the Germans to take advantage of the initiative, which it was conceded now lay in their hands if they desired to avail themselves of it, the possibility of an offensive by the Allies began to be discussed by many reviewers. The Allied leaders, however, gave no serious consideration to such a move, well knowing that the Germans were laying their plans for the delivery of a heavy stroke when the time should be ripe.

The blow finally fell on Mar 21, 1918, when there was started by far the most powerful effort undertaken since the first forward thrust in 1914. The advance was preceded by a most intense artillery preparation, lasting only a few hours, but compensating for its short duration by the extraordinary number of guns which were used. It has been stated that the artillery concentration was so great that there was an average of one gun to every twelve to fifteen yards of the long front, which extended from the Scarpe, near Arras, to the Oise, in the vicinity of La Fere.

The infantry advance was started at an early hour in the morning, the first assaults being delivered against the two flanks of the British salient opposite Cambrai. Following the initiation of the offensive in the vicinity of Cambrai an advance was begun west and south of St. Quentin, the Oise being crossed at the same time farther south near La Fère. The Germans resorted to the tactics of dense assaulting lines following each other in close succession. Their losses were enormous, but by continually throwing fresh troops into the struggle the British were borne back by sheer weight of numbers. With the success of the assault against the Cambrai salient, the movement spread rapidly, until the whole British front south of the Scarpe River was engaged. The defenders of the northern part of the line fell back slowly, resisting the German advance with great stubbornness and inflicting severe losses upon the assailants. There was, however, no respite from the German attacks. Exhausted by the continual struggle and constantly opposed by fresh contingents of German reserves, who were thrown into the fight without stint, the British were forced to give ground steadily, if slowly.

In the St. Quentin sector, farther south, the defense yielded ground more rapidly than in the northern area. The difference was so marked as to lead to the belief that the southern end of the line was rather weakly held, and that most of the strength had been concentrated farther north in the belief that the Oise front would not be menaced. The retreat was made in an orderly manner and the advance of the enemy was not unopposed, but the defenders were unable to offer any adequate resistance to the overwhelming masses confronting them. The German army operating between the Somme and the Oise was under the command of General von Hutier. His troops captured Ham on Mar 23, reached Neslè the next day, and by the 26th had occupied Roye and were in position on a line extending northward from that place. On their extreme left, however, they did not succeed in moving with such rapidity, encountering serious opposition from the French troops which had crossed from the southern bank of the Oise.

One of the prime objects of the German attack against the southern end of the British line was to sever the connection between the French and British, thus permitting operations against the right flank of the latter. With a gap once opened between the Allies and the British right rolled back toward the north, the road to Amiens and thence down the Somme to the English Channel would be open. All direct communication between the Allied armies would thus be broken, leaving the Germans free to operate against either one separately, a result which would almost certainly lead to an early victory for the Central Powers.

The success which attended the first German attacks southwest of St. Quentin seemed to augur well for the attainment of the preliminary step in this ambitious plan. With the retreat of the British right flank toward the west, the line immediately north of the Oise became constantly more and more attenuated. As events were proceeding, it could be but a matter of time until the thinning of the line in this section reached such a stage that the German masses would be able to overcome the constantly weakening opposition that was being offered to their advance, and would succeed in breaking thru.

The French, however, immediately recognized the danger that was impending. Maintaining a firm hold on the southern bank of the Oise from the point where it left the former line, they began throwing troops across to the north side of the river. Until Mar 25 they covered Noyon, while further reinforcements moved rapidly northward thru Noyon to assist in checking the German advance. Some of these troops had penetrated sufficiently far to aid the British in the action at Etalon, west of Nesle, on the 25th, while they appeared in considerable strength at Roye the next day tho still insufficient in numbers to stop the Germans. By the 27th the French had taken over the entire line from L'Echelle, on the Avre River, thru Beauvraignes to the Oise southwest of Noyon. They had finally been driven from

EUROPEAN WAR—Continued

Noyon on the 26th, but still held securely the southern bank of the Oise.

In the meantime the German attacks in the northern part of the battle area had likewise met with great success. Despite the overwhelming preponderance of the German forces. the British lines in most parts of this sector held surprisingly well against the first impact of the assaults delivered upon them. Soon, however, the loss of the important supporting positions in the vicinities of the villages of Croiselles and Boursies on the northern face of the Cambrai salient and of Gouzeaucourt, Heudicourt and Villers-Faucon on its southern face so menaced the defenders that they were forced to retire along the whole adjoining front. The rapid advance of the Germans from St. Quentin also required that the British north of the Somme in that vicinity should fall back. The retirement all along the line was slow and orderly, delaying actions being fought at every favorable opportunity. By the 23rd the defensive line ran in general thru Bapaume east of Combles to Péronne, and thence southward along the Somme.

The Germans began immediate operations to drive the British from their new positions. The army of General von Below pushed southwestward from the neighborhood of Croiselles in an attempt to outflank Bapaume from the north. At the same time General von der Marwitz drove directly against the line between Bapaume and Péronne, while other groups farther south attacked the positions along the Somme. The flank of the Somme positions was uncovered by the loss of Ham, and it was not long before the Germans had secured several crossings and began to pour across the river. The troops of von Below captured Ervillers, north of Bapaume, on the 23rd, and the next day stormed the heights of Monchy and entered Achiet-le-Grand. Under this threat the British withdrew from Bapaume on the evening of the 24th, after the Germans had been repulsed in a furious struggle which had been raging around the town. By this time Péronne, too, had fallen and the British were retiring to the west along the whole sector. On the 25th von Below reached the Ancre at Irles, where he gained contact with the forces of General von der Marwitz which had pressed in south of Bapaume.

At this stage of the operations the British line north of the Somme ran thru Bray, Albert, Beaumont-Hamel, Puisieux, Bucquoy, Boiry, Henin, just west of Monchy to the Scarpe, where it joined the original line. From the Somme the line extended thru Rosiéres to the west of Roye, Joining the French on the Avre River. The extensive German gains north of the Somme were now at an end. There was furious fighting thruout the rest of the month but in the main the British line in this part of the field held firmly, tho the Germans scored successes in some localities. After a slight pause for purposes of readjustment, the armies of von Below and von der Marwitz, on Mar 26 and 27, moved to the attack of Albert and the positions to the south. Albert fell on the 27th and with its loss the line as far south as the Somme, including the positions around Bray, were drawn back. Further attempts to advance here were frustrated.

On Mar 28 the chief German attack was delivered east of Arras, at the extreme northern extremity of the area of activities. This assault is reported as comparable in intensity with the overwhelming blows which had forced in the British line before Cambrai the week before. A few front line positions were taken at fearful cost, but the assailants failed signally in their attempt to compromise the defenses of Arras. It is stated that the Germans in this attack used a concentration of 20,000 men to the mile. They returned to the assault again and again, deluging the British positions with a hurricane of fire in the interims. It was not until nightfall that they finally accepted their repulse and abandoned their costly enterprise. The insistence of the Germans upon attempting to advance at this point is due to the advantageous positions which the British hold. Vimy Ridge and the Ridge of Notre Dame de Lorette command the territory both to the east and to the south. They thus not only give admirable positions for the emplacement of artillery, but also afford exceptional opportunities for observation over much of the field south to the Somme. So long as the British retain these positions their line has a firm buttress upon which it may rest, as well as a splendid base from which an offensive return might be launched at the German rear, should the present offensive be pushed much farther. In fact it would be a most unwise move for the Germans to attempt to advance any material distance to the westward, leaving such powerful positions on their flank.

The British were driven from the village of Ayette on Mar 29. The next day the British delivered a smart counterattack at Serre, retaking the village and capturing 230 prisoners. In general the last few days of the month saw a cessation of the advance on a wide front, in so far as the area north of the Somme is concerned, and the beginning of a series of local attacks for the purpose of bettering conditions at particular points. The same thing is true of the British, who made no attempt at delivering any counterattacks on a large scale.

South of the Somme we find a far different condition of affairs. Here the German advance continued steadily, tho toward the end of the month there was a tendency in the direction of a series of more or less local actions rather than the connected movement on a broad front which had characterized the beginning of the offensive. On Mar 28 the Germans entered Montdidier and Pierrepont, the general line of the advance extended almost due north from the latter point. On the 29th they took Mézierès, and an attempt to capture Moreuil, on the Avre, led to severe and protracted fighting. The Germans were at first successful but they were shortly driven out by a counterattack. The struggle continued, with fluctuating success. At the close of the day the village remained in the hands of the Allies, but their

hold was insecure and it was realized that the success was not final. On this same day the French began a series of attacks against Montdidier, which lay at a sharp bend in the German line. They were unsuccessful in driving the Germans from Montdidier, but secured the villages of Ayencourt and Montchel, just south of the key point, on the 30th.

On Mar 30th the Germans scored several gains, particularly in the region of the juncture between the French and British along the Luce. Here they took the villages of Hangard, Demuin and Abeercourt. They were immediately counterattacked and a most sanguinary engagement, lasting the entire day, ensued. The reports of the two sides are somewhat in conflict as to the final result in this section, but apparently the Germans retained most of their gains. At the same time that the struggle in the Luce Valley was taking place the Germans were driving ahead west of Montdidier, where they captured Mesnil and Fontaine. An attempt on the next day to extend the gains in this vicinity to include the village of Grivesnes was repulsed by the French.

The immediate objectives of these last mentioned German attacks were the Amiens-Paris railroad, which runs north and south only a few miles west of the battle lines, and the city of Amiens itself. Amiens is located on the Somme a short distance below its junction with the Avre, in the valley of which the Germans are now operating. It possesses great importance as the junction of all the roads and railroads in this section of France. It is, moreover, the main British base for all the armies on this part of the front. The capture of Amiens would prove a most severe blow to the Allies. The German drive toward Amiens in the last days of the month made such slight progress that it might be said to have been stopped. There were, however, evidences that the Germans were making heavy concentrations of troops for a renewal of the attempt.

The last few days of March saw most furious fighting along the line from Montdidier thru Lassigny to the Oise south of Noyon and along that stream to the east. Both the Germans and the French made assaults upon the positions held by their opponents, and each recorded some successes. The net result of the operations in this sector was, however, practically without effect upon the positions held by the opposing armies, the general line remaining essentially as it was before.

As the month closed it appeared that the first phase of the great German offensive was about at an end. The initial rapid advance by which the Allied forces were overwhelmed and swept back over the whole front had stopped. As the general advance became slower it disintegrated into local attacks delivered against particular sectors of the line. These in turn became smaller in the extent of front assaulted and in the depth of penetration secured, until by the end of the month the advance had practically ceased. It is not to be supposed, however, that the offensive is at an end. Under modern conditions it seems impossible for offensive operations to be continued without intervals of comparative inactivity. These are necessary for readjustments in the attacking forces, for relieving the spent troops by fresh reserves from the rear, and above all for bringing up the artillery and the enormous quantities of ammunition and supplies which are now required for the successful prosecution of any offensive movement.

There is little doubt that it is such a temporary pause which was taking place in the German advance at the end of March. An early renewal of the attacks may be looked for, not improbably accompanied by blows at other parts of the line in the hope that the British will have so concentrated their reserves at the threatened sector of the line that other portions will be found weakly held. There have as yet been no indications that the British strategic reserve (on the supposition that there is such a reserve in being behind the British lines) has come into action at all. The progress of the actions has been such as to make it appear that nothing but local reserves have been thrown into the struggle. It is still too early to attempt to guess what the ultimate plans of the Allied commanders may be. The delay in the operations will prove of at least as much advantage to the Allies as to the Germans, since it will give them a respite in which to increase the strength of their positions and to rearrange their troops to meet the renewal of the drive when it comes.

The mass tactics employed by the Germans in their attacks has already been referred to. The dense attacking lines offered ideal targets to the artillery and machine guns of the defenders, so that the German losses were very heavy, as must inevitably be the case under such circumstances. All accounts of the fighting, including the Allied official statements, commented extensively upon this phase of the offensive. Some estimates placed the German losses during the first week of the operation at five to six times those of the Allies. These estimates are undoubtedly too high. The attackers would certainly suffer greater losses than the defending troops, but in an offensive like the one now under consideration, where the advance was at first steady and continuous, the retreating forces are unable to observe the ground over which the attack progresses, and are consequently without any reliable data upon which to base their conclusions. The large numbers of prisoners which are necessarily lost under such conditions also tend to reduce the disparity between the casualties of the two sides.

No reliable figures as to the losses have yet been given out. On the 29th it was reported from Berlin that 70,000 prisoners and over 1100 guns had been captured. London stated, however, that the British losses in guns had been just over 600. Of course the Germans took enormous quantities of munitions and supplies in overrunning such a large extent of territory. They report that among other things they

EUROPEAN WAR—Continued

captured many British tanks, 100 of which fell into their hands at one point, evidently a "tankdrome." The German tanks came into action after the first days of the advance, and are stated to have given a good account of themselves. It would appear that the German tanks, of which we have before heard only the vaguest reports, are of two classes. One of these is considerably larger and more powerful than any heretofore employed, while the other is smaller and faster. The Germans also used a number of the captured British tanks, turning them against their former owners.

The American troops in France have not yet entered into any extensive operations. More and more are, however, constantly coming into the front lines for training. During the month they took part in a number of raids and patrol encounters, in some cases by themselves and in others in conjunction with the French troops in whose company they have been gaining their experience in modern methods of fighting. In addition to the American sector proper, on the southern face of the St. Mihiel salient, United States troops have appeared at four other points along the front, where they were associated with the French. One of the most active of these additional sectors was east and northeast of Lunéville.

On Mar 29 it was announced that General Pershing had offered the entire resources and manpower of the American forces to the Allied high command for use when and where desired. The offer was promptly accepted. Up to the end of the month there was no news to indicate what use would be made of the Americans, but it was freely predicted that some of the divisions which had been longest in training would be sent at once to the scene of the German drive, and there thrown into the struggle against the advance of the invaders. It is stated that General Pershing is in a position to furnish about 100,000 men capable of being used at once. The American troops were reported on the move at the close of the month, but nothing was given out as to the direction of their march or its destination.

The first days of April witnessed nothing more than local actions on the front of the German drive, tho the fighting in some of these affairs was of the severest character. Ayette, which had been taken by the Germans on March 29, was recaptured by a British counterattack on April 12, together with 100 prisoners. On this same day the British took 73 men and a section of the German position north of Serre, while the French scored a slight success in the Lassigny sector. The Germans did little attacking north of the Somme at this time, but there was considerable fighting south of that stream.

On the morning of April 4 the Germans launched an attack against the French and British on the whole front from Grivesnes north to the Somme. The British center and right held fast, all the assaults of the enemy being repulsed. Just south of the Somme, however, the Germans were more successful. Here they gained ground in the vicinity of Hamel and toward Vaire Wood, southwest of the town. Their maximum penetration was about 1000 yards. Despite this initial gain on a part of the front attacked, the Germans did not continue the movement. It would seem that the results secured were not sufficiently encouraging to justify a continuance of the assault. The advance south of the Somme was secured only at a great cost and as a result of the employment of overwhelming masses of troops, six divisions having been used on a front of 9000 yards. On the 5th the Germans shifted their attacks against the British to the north side of the river. The front of the assault extended from the Somme to Bucquoy, a distance of about sixteen miles. Some slight initial gains were made between the river and Albert, but British counterattacks recovered most of the ground lost.

The attacks against the French in the angle between the Luce and Avre rivers and west of the latter stream were pushed with greater persistency. The first assault was delivered with a concentration of 20,000 men to the mile and succeeded in making gains at a number of points. The villages of Morisel (across the river from Moreuil) and Mailly-Raineval (three miles to the southwest) were captured on the 4th, but the heavy assaults on Grivesnes failed, due to the fierce French counterattacks. On the next day the Germans secured possession of Castel, bringing them within two miles of the Amiens-Paris railroad. With these successes they had to be content. A constant alternation of attack and counterattack resulted in little change one way or the other. The French retained control of the heights near the new German positions. Whatever advantage there was to either side as a result of the rather confused fighting rested with the French.

In the meantime the Germans had transferred their attention farther to the east, advancing against the exposed French positions south of the Oise below La Fère. The French here occupied an uncomfortable salient jutting to the northeast at the point where the Oise intersected the battle line as it had existed prior to the initiation of the German offensive. Following a night of intense artillery bombardment, a series of violent attacks was launched by the Germans south of Chaulnes and at Barisis on April 16. The French resisted stubbornly and inflicted heavy losses upon the attackers. The French positions at this point were not without value as they might serve a good purpose at some future time as a base for the initiation of a possible offensive up the Oise. Their retention in the face of a determined attack would, however, be extremely costly as they could be raked by artillery fire from two directions. It was decided that the importance of the salient did not justify the expenditure of men that would be necessary to hold it. Preparations were accordingly made for a retirement to the line of the Ailette.

The withdrawal was not made rapidly. Instead

the French fell back grudgingly and in perfect order. The Germans were forced to pay dearly for every advance they made, the defenders keeping their foes under a destructive fire at every opportunity but falling back each time before the engagement had become so closely joined that disengagement was difficult. Verneuil, Folembray and Pierremande fell into the hands of the Germans on the 7th, but it was not until two days later, and after a defense which had exacted a disproportionate price from the assailants, that the French abandoned Coucy-le-Chateau, Quincey and Landricourt to fall back to the line previously determined upon. This new line approximately follows the Ailette River from its junction with the Oise southeastward to Anizy-le-Château. It is much more favorably located for defense than was the salient which was given up, conforming much better to the extension of the line to the east and west. The French loss during this operation was slight, while they inflicted severe casualties upon their opponents.

On April 8 the German artillery, which had taken but a small part in the recent opoerations, again came into action in great strength. Thruout the day there was kept up an intense bombardment of the British positions on different parts of the front from south of the Somme to the vicinity of Ypres, far to the north of the scene of the late activity. The greatest artillery effort seemed to be centered about Bucquoy, about half way between Albert and Arras. It was evident that the Germans were about to start a new attack, and it appeared reasonable to suppose that the Bucquoy sector might be selected as its objective.

The fundamental German concept in the 1918 offensive was and is to push thru to the English Channel, thus separating their foes into two forces, and leaving them free to turn their attention wholly against the northern section. The initiation of the offensive movement had left them in possession of a wedge pointing toward Amiens. From the point of this wedge to the Channel is about forty miles, little farther than they had already advanced. They did not dare, however, to push the wedge much farther without widening its front. To do so would be to invite disaster should an Allied counter-offensive push in either of its sides. Before any extensive advance down the Somme could be undertaken they must push forward the base of their wedge, converting the tactical salient into a strategical one. Their disastrous attacks before Arras and in the Albert region had been for this purpose. The heights back of the village of Bucquoy had thus far proved a stumbling block in the path of the Germans despite the many strong local attacks they had directed against them. Could these hills be taken, the invaders might hope to press on westward, taking in reverse the line to the south about Albert and to the north around Arras. It is thus readily understood why the reports chronicling the resumption of artillery activity should have selected Bucquoy as the scene of the new blow which was momentarily expected.

The German designs, however, were even more ambitious than had been anticipated. Instead of attacking south of Arras they delivered their stroke well to the north, around Armentières, the extreme right of the section that had been covered by their artillery preparation. At this point the Germans were no farther from the sea than at the end of their wedge before Amiens, while the flat country presented fewer difficulties to an advance than did the positions around Bucquoy. Any extensive gain west of Armentières would threaten the British Army with being cut in two, while by spreading out to the south the strong positions about Arras could be endangered, possibly forcing a retirement along the whole line north of Amiens.

Once more the Germans took advantage of any lack of coordination that might exist between two armies speaking different languages, by striking at the section of the line held by the Portuguese. The front of attack was extended to include the British elements on either side of the troops of the youthful republic. Altogether a front of about ten miles, from the La Bassée Canal to the neighborhood of Armentières, was affected.

The advance was started at 5:15 on the morning of the 9th. It was aided during the early hours of the morning by a dense fog which enshrouded the battfield, making observation impossible. At first the attacking troops were successful along the whole front, but the British flanks soon arrested the progress that was being made against them. Indeed, on the southern flank, Givenchy, which the Germans had entered in their first rush, was recaptured by a counterattack. In the center, however, the Germans met with greater success. Richebourg, Laventie and Fleurbaix were shortly taken and by nightfall most of the territory south of the Lys as far as the Lawe was in the possession of the attackers.

On April 10 the Germans forced the Lys after a protracted struggle, crossings being effected near Estaires and at Bac St. Maur, about seven and four miles southwest of Armentières respectively. The Lawe River was also crossed at Lestrem, but a counterattack recaptured the village and drove the enemy back to the east bank of the stream. This temporary success was all that the Germans accomplished on the front between Estaires and Givenchy. Here the defenders held firmly to the line of the Lawe. By their gains on the Lys, however, the attackers had completely severed the communications of Armentières from the southwest.

Nor was this all. A second attack, aimed to work in behind Armentières from the north, was started early in the morning of the 10th, while the fighting along the Lys was at its height. This assault covered the front from a point just north of Armentières to the Ypres-Comines Canal. As a result the British were pressed back to the eastern slopes of the Wytschaete-Messines Ridge and to a line running south from the ridge to Ploegsteert. Armentières was thus menaced from all directions except the northwest. It was decided that its further retention could serve no good purpose and might lead

EUROPEAN WAR—Continued

to heavy and unnecessary losses. The city was accordingly abandoned during the night of the 10th and the early part of the next day. In the last hours of the British occupation of Armentières, the Germans threw into the city a perfect rain of gas shells. So dense did the fumes become that the attackers were unable to enter the city for many hours after it had been abandoned.

The Germans attacked furiously all along the front on the 11th, the assaults lasting for many hours. Their efforts were unavailing on the two flanks, both along the Lawe and before Hollebeke and Wytschaete, where they were completely repulsed. They made progress in the center, however, especially in Ploegsteert Wood and in the regions of Estaires and Steenwerck, the latter five miles west of Armentières.

The German line now ran along Messines Ridge and south to Ploegsteert, from which point it swung west and south on a great arc extending north of Nieppe and Steenwerck, and east of Estaires, touching the Lys about at its intersection with the Lawe, which stream it followed to the southeast. The attacking army now devoted itself to the task of extending this semi-circular salient. Berlin stated that up to this time their troops had captured 20,000 prisoners, including one British and one Portuguese general, and 200 guns.

For the next few days the Germans advanced steadily, if slowly, in the face of the stubborn opposition offered by the British. On the 11th they cautured Merville and Neuf Berquin, some four miles west of Estaires. The next day they continued their advance in this direction as far as the edge of the Nieppe Forest. They also effected the crossing of the Lawe River, advancing a short distance west of that stream. Farther north the British were pressed back to the Bailleul railroad and thru Ploegsteert Wood to the vicinity of Neuve Eglise, which the Germans occupied late in the evening. A British counterattack next morning recovered Neuve Eglise. Thruout the 13th and 14th the Germans attacked repeatedly at many points along the line, only to suffer heavy losses without compensating gains, as their desperate assaults were repulsed as regularly as they were launched. The attempts to advance were especially persistent before Neuve Eglise, on the front opposite Bailleul, and west and northwest of Merville. The only success attained was at the village of Merris, southwest of Bailleul, until the night of the 14th, when the defenders of Neuve Eglise were finally overwhelmed and the town passed once more into German hands.

With Neuve Eglise safely in their possession, the attackers turned their attention, on April 15, upon Wulverghem, two miles to the northeast, at the same time redoubling their efforts to capture Bailleul. Wulverghem, exposed to attacks from the east, south and southwest, fell in the evening. Bailleul resisted the assaults directed against it, but the Germans finally gained possession of the heights forming its defenses on the east. Thus exposed to attacks from two directions and with their positions commanded by the forces on the eastern hills, the Briish were forced to give up the town which they had so gallantly defended and at such great cost to the assailants.

On the 16th the Germans launched an assault on the whole front from Wytschaete to Meteren, about a mile west of Bailleul. On the greater part of the nine miles of attack no gains were recorded. At the extreme western end they fought their way into Meteren, but failed to advance north of Bailleul. At the other extremity of the front there was a far different result. Here they took practically all of Messines Ridge, including Wytschaete at its northern end and Spanbroekmolen, the central and highest point. The struggle was most intense, but the British were once more borne back by vastly greater numbers. Later in the day the ground about Wytschaete and the village of Meteren were regained by counterattacks, only to be lost again the next morning when the Germans once more took up the offensive. This attack on the 17th was on the twelve mile stretch from the Forest of Dieppe to Wytschaete. It was repulsed everywhere except at Wytschaete and Meteren, where the Germans once more secured the ground they had overrun the day before.

The capture of Messines Ridge was an important success for the Germans. Primarily it gave them a strong protection for the northern base of their offensive salient, minimizing any danger of a British counter from this direction. It further gave them an excellent vantage point to assist in the extension of their salient to the north, threatening the city of Ypres, only five miles north of the ridge. The danger to Ypres was possibly not acute, as its approaches from the west were still protected by the series of hills running in a general westerly direction from Messines. These were all in the hands of the British and their reduction would necessarily be a slow and costly process. At the same time the German menace was evidently considered sufficiently grave to necessitate precautions against any further advance. Accordingly the British lines north and east of Ypres were drawn in closer to the city to lessen the likelihood that the troops in those positions would be dangerously affected by additional enemy gains south of the city. The exact extent of this retirement has not been stated. It would appear, however, that the British have drawn back to the western edge of Passchendaele Ridge and well to the south of Houthulst Woods. The German statement announced that their troops had occupied Passchendaele, Poelcappelle and Langemarck, and had advanced near Becelaere and Gheluvelt. There was thus abandoned without a struggle much of the ground won at the cost of such desperate fighting in the British Flanders offensive of last year.

On April 18 the Germans suddenly shifted their main attack from the northern to the southern flank of the Lys salient. After a heavy shelling, a series

of powerful infantry assaults was delivered on the front from Givenchy eleven miles northwest to the Lys west of Merville. The Germans were repulsed at every point, losing heavily as a result of their persistent massed attacks. Later in the day they renewed their efforts northeast of Bailleul, only to meet another check here. It was announced on the 18th that the French reserves, which had been despatched to the aid of the hard pressed British, were beginning to arrive on the scene in force and were taking over a part of the line on the northern face of the salient.

There now ensued a week of comparative inactivity in the Lys sector. The Germans entirely discontinued their operations on a large scale and the battle lapsed into a succession of local actions which led to little result either way. If anything the advantage lay with the British, who recovered some ground at different points along the line. None of these gains were of any especial importance, however. It was evident that the Germans were getting ready for a resumption of their offensive in force, and the Allies took advantage of the opportunity to make such preparations as were possible to withstand it.

When the German blow came, it led to some of the most severe fighting of the war. The obvious intention of the German leaders was to push rapidly northward upon Ypres and its western approaches, with the idea of cutting off the retreat of the British forces to the east of the town before they could be withdrawn. This involved forcing their way thru the chain of hills previously referred to as stretching westward from Messines Ridge. Their main efforts were concentrated against the most easterly of these heights, Mont Kemmel. Successful at first, their attempts to continue their advance to the north led to such a severe repulse as to make the whole operation a serious reverse rather than the victory which the opening events seemed to portend.

The offensive opened on April 25 over the front from Bailleul to Wytschaete, the principal attack being directed upon Mont Kemmel. This height and the country for some distance on each side were held by the French who had come to the assistance of the British the week before. Following one of those sudden and overwhelming bombardments from an enormous artillery concentration, such as we have come to expect as the preliminary to all German offensives this year, the infantry attack was sent forward in dense waves. The heavy attack against Mont Kemmel and the villages of Dranoutre and Kemmel, at its west and northeast bases respectively, was delivered by fresh divisions brought into the area for this special purpose.

Little progress was made against the slopes of the height itself, but the villages at its foot were taken after a desperate struggle. The hill continued to hold out, tho now exposed to attacks from three sides. Later in the afternoon the Germans began forcing their way slowly around the base of the hill. By nightfall it was completely surrounded. The German flanking party on the west side pushed into the village of Locre, but were ejected by a French counterattack. The French regiment on Mont Kemmel held out for several hours longer, but was finally overpowered. Farther to the east the British were forced back to a line thru Voormezeele and Zillebeke, along the Steenbeck.

On the 26th the Germans attempted to press their advantage but suffered a general repulse, despite their repeated assaults, which came on, wave after wave, heedless of the frightful losses inflicted upon them. On the extreme left only did the attackers succeed in gaining. Here the village of Locre, after changing hands five times in the course of the day, finally remained in the possession of the Germans. The French recaptured the village the next morning.

For the next two days the fighting was almost continuous and of the fiercest description, but resulted in little advantage for either side. On the 29th the Germans launched another general attack along the whole front south of Ypres, while by a separate operation they attempted to advance upon the town from the north at the same time. Once more their assaults were beaten back disastrously. At the few points where they made initial gains they were later thrown out by counterattacks. So badly broken were von Arnim's troops that they did not attempt the slightest acivtity on the succeeding day, even the local fighting being reduced to the absolute minimum.

During the first part of the operations south of Ypres, the battle front east of Amiens remained comparatively quiescent. There were a number of local actions and raiding parties were active, but nothing occurred to change the situation materially. On April 23 the Germans began an artillery bombardment preparatory to resuming the offensive. Altho the artillery was active over a considerable part of the front, the heaviest concentration was from Hangard, on the Luce, north to the Somme. This is the sector where the French and British forces join, and it was here that the German attack was delivered.

Beginning shortly after daylight on the 24th, the German assaults led to fighting of the fiercest description, continuing all day and much of the night. On the flanks of the attack the Germans were repulsed, but they met with better success toward the center, from Hangard to Villers-Bretonneux. The British were driven from the latter village early in the operation. To the south the French fell back doggedly, making frequent counterattacks, but the Germans were not to be denied and pressed slowly on, thru Hangard Wood and into the edge of the village of Hangard. During the night the Germans concentrated their attention on the village. By morning they had swept it clear of the French, who organized their new defensive lines on its western outskirts. In the fighting in this area, the French were assisted by American units according to the Paris reports.

Spent by twenty-four hours of continuous fighting, the troops of both sides remained quiet about Hangard on the 25th. The British counterattacked at

EUROPEAN WAR—Continued

Villers-Bretonneux on the night of the 24th-25th, retaking the village and most of the adjoining ground which had been lost. On the 26th there was a general allied counterattack which recovered Hangard wood and village together with the other positions that had been lost. The Germans countered immediately, making as many as seven distinct assaults at one point north of Hangard Wood. The action finally closed with the Allies in possession of all the ground they had regained, except in Hangard itself, where the Germans held the eastern half of the village. This closed the major operations in the Somme region.

The western front outside the main battle areas showed little of interest during the month. A few local actions at different points were mentioned in the despatches, but apparently the minor activities were considerably less than in the last few months.

The American troops are gradually coming into action on various sections of the front. Mention has already been made of their presence with the French at Hangard. They have also appeared on the French front south of Grivesnes, where they were attacked while entrenching between Cantigny and Fontaine-sous-Montdidier. A British report early in the month stated that American infantry, engineers and aviators had arrived on the British front.

On the American sector proper there were a number of minor affairs and one considerable action. Several times during the first half of the month the enemy initiated raids and local attacks, only one of which penetrated to the American trenches. This was on April 14, when a specially selected body of shock troops, fresh from the Russian front, gained the front line. They were driven out in hand-to-hand fighting, leaving sixty-four dead and ten wounded.

On the morning of the 20th, following a heavy bombardment which began at sunrise, the enemy launched against the American sector in Lorraine the most violent attack that our troops have yet experienced. The assault covered a front of about a mile and a half just north of the village of Seicheprey. The attacking troops forced the defenses of Seicheprey, and pushed thru the village, but were stopped about a half a mile to the south. Farther east they penetrated Remières Wood. The Americans promply counterattacked. By nightfall they had regained the village. On the next day a continuation of the counterattack, in which French troops also participated restored the entire position. The Germans claim the capture of 183 Americans. The other casualties have not been announced, but it is reported that 300 German dead have been counted. It is not improbable that the American losses were approximately the same. The German reports of the engagement commented upon the vigor of the resistance that was offered to their original advance, especially in the village, where there was apparently a house to house defense.

From the end of April until the last days of May the Allied line was almost wholly free of the pressure which had been maintained against some part of it continuously for the preceding six weeks. The sudden cessation of the German activity seemed to lend emphasis to the fact that they had suffered an even costlier defeat than at first reported in the repulse to their attack of Apr 29 on the lines south of Ypres. No further attempt was made in any considerable strength to follow up the advantages that had been gained previously. Instead the broken shock troops were withdrawn to the rear, and the Germans manifested a willingness merely to restrain the Allied counter attacks. Such actions as they did engage in were strictly local in character.

This change of attitude on the part of the Germans was not taken to indicate that they had abandoned their offensive plans. There were constant reports of fresh divisions being hurried to the western front in considerable numbers. It was further reported that the garrisons in the interior of Germany were being replaced by troops from Austria-Hungary, the forces relieved in this way being sent at once to the West to replace casualties. Toward the middle of the month many of the crack divisions were withdrawn from the front line and put in training with the reinforcements in rear.

It was evident that a new blow was impending. There was, however, a question as to where it might be expected to strike; whether an attempt would be made to push the existing wedges farther into the Allied territory, or an entirely new sector be chosen for the blow. Many observers thought that the front between the Amiens and the Armentières salients, in the vicinity of Arras, would be the scene of the next great attack. Some color was lent to this theory by the reports of the aerial scouts that the heaviest concentrations seemed to be near and south of Arras.

According to the latest Allied estimates, based upon what is believed to be accurate information, the total strength of the Germany army is now about 5,300,000 men. This is about twice the size of the army at the beginning of the war, but 1,500,000 less than in August, 1916, when at its maximum. On the western front there are estimated to be 3,600,000 men; about 1,200,000 more than a year ago. Of this increase, about three-fourths came from the eastern front, the remainder being recruits.

The estimate placed 203 German divisions on the front from the Belgian coast to Belfort. Of these about 150 were known to be between the sea and the Oise River, the supposed distribution being about as follows: 10 divisions between the sea and Ypres, 40 between Ypres and La Bassée, and the remainder from La Bassée to the Oise.

At the beginning of the great German offensive on Mar 21 the Allies were outnumbered by about 300,000 infantry. It has been officially given out that the British losses have been approximately 250,000 men since then. The French have probably lost from 50,000 to 75,000 in the same time. As to the German losses there are many estimates varying between wide limits. Some authorities place them as low as 250,000, others as high

as 600,000. Considering all the elements of the case it is not improbable that the total German losses are not greatly in excess of the combined Allied casualties. About sixty per cent of the wounded, however, will be returned to duty before the end of the summer. In this respect, the Germans have an advantage, since a large proportion of the British losses are in prisoners (100,000 claimed by Berlin).

It is probable that the Allies now outnumber their enemy, with the arrival in France of the Italian and American reinforcements. The preponderance should henceforth become greater and greater in their favor, as the United States throws more of her strength into the scale. Austria is generally considered to offset Italy and no more, so her strength can not be counted. All the increase that Germany can expect in the future therefore comes from her own available recruits, estimated at 600,000 per year.

The uncertainty concerning the designs of the enemy made the disposal of the Allied reserves a difficult problem. While awaiting a definite disclosure of the German intentions the Allied troops delivered a number of minor attacks on various parts of the front in an effort to rectify the alignment in some of the weaker spots as well as to seize advantageous strong points in advance of the line where they must make their main resistance. These actions were begun immediately when it became apparent that the heavy German blows were temporarily at an end. They were carried out in both the northern and the southern sectors of recent German activity.

On the night of May 1 the French advanced their lines slightly in Hangard Wood, while the next day they occupied Baume Wood, southwest of Mailly-Raineval. Late on the 2nd the French attacked south of the Avre between Hailles and Castel, capturing Hill 82 and the wood bordering on the Avre. The British troops near Hébuterne, north of Albert, made a local gain on the night of the 4th. At the same time an Australian force advanced 700 yards on a front of 1500 yards between the Ancre and the Somme, southwest of Morlancourt. Two nights later this gain was extended along a further frontage of 2000 yards just to the north. These two gains together were of considerable local importance as the positions taken lay along the crest of a small ridge giving observation for a long distance up the valleys of the Ancre and the Somme. For the next two weeks little of interest occurred in the Somme salient. The Australians slightly increased their gains southwest of Morlancourt, but this did not materially affect the situation there. A German counter attack here met with some preliminary success, only to be driven back immediately thereafter.

The only remaining one of these local actions in the Somme salient which is worthy of comment, apart from the American attack at Cantigny which will be described later on, was the capture of Ville-sur-Ancre by the Australians. This village is somewhat less than two miles northwest of Morlancourt. A sudden assault following a brief but heavy bombardment drove the Germans from the village on the night of May 18, with a loss of 360 men and 20 machine guns. With the village the attackers secured a small ridge overlooking Morlancourt from the north. The importance of this gain, which was made at trifling cost, lies in the fact that the new British position here, taken in conjunction with the ridge southwest of Morlancourt captured during the first week of May, will effectually guard the bridgeheads farther west. These positions were formerly none too safe from a sudden German advance westward from Morlancourt. Now no attack of less than major proportions could hope to accomplish much against them.

In the Lys salient, south of Ypres there was considerable severe fighting during May, tho all in the nature of local operations. Following the heavy repulse met by the Germans in their last big attack in April, they evidently abandoned all idea of forcing their way straight thru the Allied line by a continuation of their battering-ram tactics. Instead they fell back upon a strict defensive for a short time, and then began a series of local attacks. Tho somewhat disconnected, each of these attacks was made in sufficient strength to endanger the section of the line against which it was directed and to make it questionable as to just how serious the attempt might be. In this way the Allied command was kept in doubt whether or not a resumption of the main movement was in contemplation. To increase this indecision on the part of the Allies, the Germans kept up intense bombardments of their enemies' positions.

On the night of May 3 the British made slight gains northeast of Hinges, on the southern face of the Lys salient. A local attack by the Germans south of Locon early in the morning of the 4th was completely repulsed. At the same time the French near Locre and the British near Meteren made local advances. The next morning the Allies attacked again in the Locre region, advancing 500 yards on a front of 1000 yards. In this attack the Germans were driven from several ruined farms and from some high ground at Koutkot, west of Dranoutre. These successes were of distinct value in strengthening the defenses of the approach to Mont Rouge and Scherpenberg.

On May 8, following a violent shelling of the Allied lines, the Germans assaulted the five miles of front between the villages of La Clytte and Voormezeele. The French repulsed all the attacks against their portion of the line behind the Vyverbeek Brook, but the British in the neighborhood of Dickebusch Lake, farther to the northeast, were less successful. Here the Germans penetrated the positions for several hundred yards, only to lose all that they had gained when the British counterattacked during the night. The Germans returned to the assault the next morning and entered the front line, but were later ejected. While these operations were going on the French pushed forward a short distance south of La Clytte.

The French forces co-operating with the British on the northern face of the Lys salient continued their attempts to improve their positions near Locre. In an attack north of Kemmel on May 12, they stormed Hill 44, which the Germans had taken at the same time they captured Mt. Kemmel. The French were driven from this vantage point, which commands a portion of the bottom of Vyverbeek Brook, by a German counter-

EUROPEAN WAR—Continued

attack on the night of the 13th. The hill was retaken the next day and remained in the possession of the French. The latter did not rest here, however. On the night of May 19 they once more attacked east of Locre, this time on a front of 4000 yards. No attempt was made to push forward to a great depth, but all objectives, including several points of local importance, were attained. Among the strong points secured by the French were the ruins of Brulooze, the hospice of Locre, Klein Vierstraat cabaret and the Pompier Estaminet, as well as two or three farms.

With these successes, the French apparently decided that they had accomplished enough for the time being, and stopped their attacks. On the 27th the Germans made a determined attempt to retrieve their recent losses. They attacked in strength along the front from Locre to the Ypres Canal. This entire section was now held by French troops, their front having been extended to include the line south of Dickebusch Lake shortly before this time. Despite several desperate assaults the Germans were unable to make headway at any point except south of the lake. Here they secured a temporary lodgment in the French positions, but were later thrown back.

In the meantime the other portions of the Lys salient were not inactive. The Germans made a number of attacks, some in considerable force, on the southern and western sides of their wedge. These attempts to gain were unsuccessful without exception and will consequently not be discussed. A British attack, on the evening of May 20, northwest of Merville, at the extreme western point of the salient, made a small gain and captured a number of prisoners.

There were a few small local attacks by both sides at other points on the long front besides the areas of the former main operations, but none of these secured results of sufficient importance to warrant mention.

The anticipated resumption of the German major offensive came on May 27 at an entirely new point on the front, and one that was very evidently not considered a probable danger spot by the Allied command. This was the section of the line between Soissons and Rheims, about thirty-five miles in length. The sector subjected to this latest German blow has long been considered one of the strongest of the entire western front. It would appear that the Allies believed this so firmly and were consequently so thoroly convinced that no attack would be delivered here that the positions were but weakly held. Of this fact the Germans took full advantage, delivering their attack against what was recognized as an extremely strong position, but one which might, for that very reason, be expected to contain only a small garrison.

The new German blow was a repetition of the tactics which were so successful in their other recent offensives, that is a sudden and unforeseen stroke of great power, accompanied by the light guns and mortars recently developed for overwhelming the trench defense, and preceded by a short but extremely violent artillery bombardment. The system is attributed to General von Hutier, who used it so successfully against the British Fifth Army before St. Quentin in March, after first employing it in a less perfected form in the capture of Riga last year. The essence of the plan is an elaborate logistic scheme by means of which the assaulting troops can be rapidly assembled at the last moment. The reserves of shock troops are placed twenty or thirty miles or even more from the front. When the moment for the advance arrives, these troops are brought up to the point of attack by forced night marches, being thus concealed from aerial observation and bringing back the element of surprise, which some writers had believed to be one of the lost factors in warfare. There are other advantages to the plan. The troops arrive well shaken down and prepared for a rapid advance into the enemy's territory. They need not all be brought up at the same time, but each unit can be so timed that it will arrive at its proper place just when its presence is desired, avoiding the congestion in rear that would otherwise occur. Another point that might be added is that the exact point of attack may be changed to meet later information with a minimum of trouble. Being well back of the line, the reserves may be sent to any point within a considerable range, thus giving the leader greater latitude in making his general plan flexible.

Like most other things in warfare, the new plan, if correctly described in the despatches, is not really new at all. It is merely a development of the old strategic assembly on the field of battle, robbed, however, of the dangers which formerly attended the movement, since the concentration is protected by the entrenched troops in front.

The sector of the Allied line struck by this last German offensive was held by both French and British troops. The former occupied the positions as far east as Craonne. From there a British force held the line to a point near Rheims. It is understood that there were four British divisions in this region, which had heretofore been solely French.

On the German side the Aisne sector is under the command of the Crown Prince, with General von Below in charge of the left wing and General von Boehm of the right. The German units that delivered the attack seem to have been very largely the same ones that were recently employed against the British in the north. Upon being withdrawn from the British front for reorganization they were despatched to the Aisne region, and the new attack was started as soon as these shock troops were in condition to strike again. According to the best information that can now be obtained twenty German divisions were used in the first assault. Their distribution was not uniform, however. At the point selected for the main blow, it is stated that there was one division to the mile. This concentration was increased as the attack progressed. Reinforcements were thrown into the struggle with great rapidity until there were forty-five German divisions engaged. The Allied reinforcements were, of course, much slower in reaching the scene. For a considerable time there were, to oppose these masses of attacking troops, few more than the original defenders, believed to number not more than fifteen divisions in all. At the critical points the Germans had a preponderance of four to one, or even greater odds.

The first attack fell with its chief force on the French

to the west of Craonne. The line was quickly pierced at this point, endangering the French farther west and the British before Rheims. These troops on the flanks had successfully withstood the assaults directed against their fronts, but they were compelled to move back their inner flanks to conform to the movements of the defeated center. As soon as this state of affairs became evident to the Allied commanders, it was decided to make no attempt at a definite stand north of the Aisne. All the troops engaged were accordingly withdrawn, no more resistance being offered than was necessary to effect their extrication. This action was doubtless essential to avert the danger of a rupture of the line. It had the disadvantage, on the other hand, that the Germans arrived at the river so quickly and in such good order that it proved impossible to stop them there.

Before nightfall of the 27th the French in the center of the line were south of the Aisne at Pont Arcy. During the night the pursuing enemy threw a column across the river near that point, and continued the advance to the south without waiting for the flanks to conform. On the 28th the point of the wedge thus formed reached the Vesle River at Fismes, the river being crossed on both sides of the town. This represented an advance of ten miles from the positions occupied two days before. In the meantime, the German elements on the sides of the wedge had been attacking fiercely in an attempt to widen out the salient that was being formed. Here the defenders were more successful than in the center. The Germans gained relatively little by their desperate assaults, while they incurred heavy losses. The Allies were, however, driven back at some few points. Late on the 28th the defenders on both sides of the base of the wedge were withdrawn for some distance to conform to the retreat of the center. This was necessary to prevent too great an extension of the front before the arrival of reinforcements. The next day this retirement on the flanks was continued under heavy German pressure, to the environs of Rheims on the east and to the western outskirts of Soissons on the other side. At the same time the Germans in the center advanced their lines about four miles more.

At this stage of the operation there began to be seen the first evidences of any real attempts on the part of the Allies to oppose an active resistance to the German pressure southward. The French organized a line of resistance thru Fère-en-Tardenois and along the heights south of the Vesle. The defenders were not in sufficient strength, however, successfully to oppose the masses of their adversaries. The German advance was delayed but it could not yet be stopped. The French opposition was brushed aside, and by the end of the month the invaders had reached the Marne between Dormans and Château-Thierry. The reports at that time did not indicate just how much of the river line had been occupied.

The main German advance began to incline rather to the west of south during the last two days of May. On the 31st an attack was delivered straight toward the west on the front south of Soissons. This rather seems to indicate that the movement is about to change its direction and swing westward. Such a change is undoubtedly the most logical outcome of the operation. A continuation of the push toward the south can lead to no especial advantage. Carrying the western side of the new salient forward, however, will join it on to the southern side of the Amiens salient, and permit of a renewal of activity there on a broader front than is now possible. In this direction, too, lies the natural line of advance upon Paris. The southern flank of a force moving westward is protected by the Marne, while nature has interposed no barriers of more than secondary importance to the advance of such a force. It is evident that herein lies the danger point of the new drive. For several days yet to come it must be expected that the Germans will outnumber the defenders. The reinforcement of the French line will necessarily be a slower process than that of the German. The invaders have not the interior position, with its consequent shorter lines of communication, but their supporting troops were already on the way when the movement started.

The attack toward the west on the 31st mentioned above was launched on the front from Soissons south. West of the city it was repulsed, but met with more success farther south. Here, despite the desperate resistance of the French and the numerous fierce counter attacks they delivered, the heavy German preponderance of fresh troops was too much and the French were forced back.

North of Soissons the Germans began on the 30th an attempt to press the French southward between the Oise and the Aisne and gain possession of the strip between the first and the last of the German salients. The German account comments upon the violence of the combat that ensued, but the French were finally forced back along the whole front from Soissons to the Oise, to the general line Blérancourt-Epagny-Chavigny. Attacks upon these new positions on the 31st were repulsed.

After the French and British on the eastern side of the new salient had fallen back upon Rheims, the Germans launched a number of attacks on the city from the west, north and east. The contraction of the Allied lines made necessary by the withdrawal to maintain continuity with the retiring troops to the west had left Rheims in a narrow salient exposed to attack from three sides. It had been feared that under these conditions the city could not be held. The defense developed unexpected powers of resistance, however, and the Germans were unable to make the slightest headway against it.

It is as yet too early to comment at length upon this latest development of the German offensive of 1918. The month closes with the operation in full swing. The Allied reserves are not yet up and the Germans are still forging ahead, tho at a somewhat slower rate than was the case in the first days. There can be no gainsaying that in this movement the German General Staff outguessed the Allied commanders. There can be no other explanation of the great success that attended their efforts. The positions attacked present unusual opportunities for the defense. The Germans had to initiate their offensive by an advance across the open valley of the Ailette, to cross that stream, and then

EUROPEAN WAR—Continued

to assault the difficult slopes of the Chemin des Dames Ridge. That they were able to so easily open a gap in the Allied line in the face of these handicaps shows that the whole operation was a distinct surprise and that the line was too weakly held. The lack of local reserves behind the Allied line is further shown by the ease with which the advance was continued after the first breach had been made. The country is made for defense. It is crossed by a succession of parallel rivers, between each two of which is found a high ridge. At least five good defensive lines were crossed with ease. It is true that there was little attempt made to take advantage of the opportunities that the country offered, and that the retirement of the defenders was made steadily and in good order. Still it is scarcely believable that no defense would have been made had the troops been present to make such defense feasible. The truth must be that the front line was but lightly held and that the reserves had been removed to some other sector where an attack was considered more probable.

Granting that the Germans were able to spring a surprise on the Allies and to gain at comparatively small cost what should have cost them dear, what has their success profited them? Thus far it is of very little value offensively. The narrow wedge they have driven south to the Marne is really dangerous tactically until it can be widened; it can serve no good purpose strategically unless it can be widened. And this widening must be done in one direction only—to the west, in order to broaden the tip of the Amiens salient to permit of a resumption of operations there on a wide front.

At the end of the month the new German front extended in a general southwesterly direction from Rheims to the Marne, along that river for a short distance, and then northward to Soissons practically along the Château Thierry-Soissons highway, jutting slightly to the west of that road at Oulchy and along the Ourcq River. From Soissons the line ran almost due northwest to the Oise south of Noyon, passing just to the north of Epagny and Blérancourt.

It is stated in the despatches that the Germans suffered extremely heavy losses as they forged ahead regardless of the cost. The Allies did not escape without severe casualties. Their killed and wounded were not as numerous as those of the Germans but they lost great numbers of prisoners. It was stated from Berlin that up to the end of the month 45,000 men and over 400 guns had been taken.

May witnessed the first offensive action of moment carried out by American troops and directed by American officers. While insignificant compared with the operations on the Aisne at the same time, it is of especial interest in that it shows how well our troops have mastered the technique of the war of positions. The scene of the attack was a small but troublesome German salient around the village of Cantigny, about three miles northwest of Montdidier. The village and its environs were strongly fortified. The captured salient was 2000 yards long and 600 yards deep.

The American artillery opened a heavy bombardment at 5:45 on the morning of the 28th. The infantry, preceded by twelve French tanks to assist in clearing the way, advanced an hour later, and within three-quarters of an hour the position had been conquered. Severe losses in killed and wounded were inflicted upon the Germans, and 240 prisoners were taken. The American losses were slight. The captured position was quickly consolidated and successfully resisted three strong counter attacks, the first of which was delivered on the afternoon of the 28th and the others on succeeding days. The strength of the American force in this sector is not known but it is assumed to be about one division.

American troops have been in action on other sections of the front where they are brigaded with French and British units. There has also been some activity on the American sectors in Lorraine, but nothing of consequence. Artillery actions and raids have been the only things reported from that front.

At the end of May the German wedge between Soissons and Rheims had been driven southward as far as the Marne and the main pressure had been diverted toward the west. The line of contact on the western side of the wedge ran approximately along the Château Thierry-Soissons road, being a little to the west of the road on both sides of the Ourcq River. On June 1 the Germans pushed ahead in the region of the Ourcq to Chouy and Veuilly, about five miles west of the highway. Farther north their attacks were repulsed, but the success of their drive along the Ourcq threw the French out of alignment. The latter thereupon withdrew to the edge of the forest east of Villers-Cotterets, the retirement being taken up nearly as far north as Soissons.

The Germans pressed forward without hesitation. Late on the 1st they seized a number of points on the eastern edge of the wooded country, including the villages Longpont, Corcy, Faverolles and Troesnes. It seemed that the defensive line was once more to be penetrated. But the French reserves had now come up in sufficient strength to mark this as the turning point in the battle. On the morning of the 2nd the French began a series of counter attacks. They quickly recovered the four villages mentioned and some of the ground nearby. The Germans redoubled their efforts and a most intense struggle ensued. A part of the French gains, notably the village of Faverolles, were wrested from them, but they retained the greater part of what they had retaken. They even extended their successes at some points, driving the Germans back at Champlat and at Hill 163, west of Neuilly. The French continued their counter attacks on the 3rd, when they recaptured Faverolles and Mont Choisy which was taken and retaken five times within a few hours. The Germans attacked again and again wherever there seemed to be any chance of success. Their attempts to advance were all in vain, however. At Neuilly Wood they were repulsed by a force of American troops who had come up to assist in checking the invaders.

This practically ended the changes of position in this area. There was more fighting of the fiercest description but it was without much result one way or the other. In the meantime the Germans had made some

advances on the flanks. On June 2 they started an advance west from Soissons which carried them forward about five miles, securing a line just west of Pernant and making the whole front almost due north and south. Here they were checked.

On the southern end of the line, just to the north of the Marne River, they did not succeed in advancing so far to the west. On June 1 they widened their tenure on the north bank of the Marne by extending the narrow point of their wedge eastward to Verneuil and westward to Château-Thierry. The part of the latter town north of the river they captured, but the French, assisted by an American machine gun command, prevented them from crossing to the south bank. Pressing on to the northwest, the Germans reached the line Bouresches-Torcy-Veuilly-le-Poterie by the 3rd. The reserves of the defenders now began to make their presence felt here as they had farther north. By June 6 the counter attacks were well under way. The French recaptured Veuilly and Vinly, while American troops drove the Germans from Torcy and Bouresches. These gains were held against vigorous enemy counter attacks and were somewhat extended during the next three days.

The center of activity now suddenly shifted well to the north—to the southern face of the original German salient. Early on the morning of the 9th the Germans opened a drive on the front from Noyon to Rubescourt, south of Montdidier. It has been estimated that the attacking force consisted of about twenty divisions, an average of almost exactly one to the mile. This force was later increased to upward of thirty divisions. The heaviest concentration was in the center and it was here that the greatest gains were made. The German center advanced on the first day of the attack to Mareuil-Lamotte and Ressons-sur-Matz. To the northeast of these points the attackers took Cuirilly and secured a foothold in the edge of Thiescourt Wood.

On the flanks, however, the defense was more successful. The first shock of the German advance drove the French from Courcelles, southeast of Rubescourt, but the village was retaken after severe fighting. South of Noyon the French positions ran along the south bank of the Divette River and the northern edge of Thiescourt Wood. Here the defenders lost none of the important ground. All assaults against them were repulsed at great cost to the attackers. As the German center continued to progress down the valley of the Matz, however, the French right was outflanked and began to withdraw to the south. By June 11 these troops were behind the lower Matz. This retirement uncovered the portion of the French line east of the Oise River. The troops in this section, who had hitherto resisted all attempts to dislodge them were accordingly drawn back over a wide front to a new line thru Tracy-le-Val and Nampcel.

Meanwhile the main effort of the offensive was continued southward thru the French center. By the evening of the 10th the Germans had taken Mery, Belloy and St. Maur and had forced the French back to the Aronde on a small front. At this time the French assumed the aggressive and drove back the more advanced enemy units. This counter pressure was continued the next day. Belloy, St. Maur and Antheuil were recaptured, as well as the hilly country in the vicinity of Courcelles. At the same time the line of the lower Matz was held against the attempts of the Germans to cross. On June 12 the enemy concentrated all his efforts on the Matz River. At considerable cost he finally gained two important lodgments on the south bank of the river—the village of Melicocq and the heights of Croix Ricard. That night the French drove the garrisons from both of these positions and threw all the German forces back to the north bank of the Matz.

The Germans made several further attempts to advance in this sector during the next few days, but were unsuccessful in all of them. After the 15th the front quieted down to normal conditions. The Germans retained gains along a front of about forty miles, much of this territory having been abandoned as a result of the threat of being outflanked and not under direct pressure. The greatest depth of penetration was between six and seven miles. The fighting during these few days is generally considered the most severe that has taken place this year. It has been stated in fact, that the war has shown nothing that is comparable with the ferocity and stubbornness of this struggle except the first two weeks at Verdun in 1916.

Altho the fighting in the neighborhood of the Matz furnished most of the interest during the second week of June, there were minor combats at various points in the Marne salient. On the morning of June 10 American forces secured the greater part of Belleau Wood, northwest of Château-Thierry. On the 12th the Germans renewed their attacks west of Soissons, between the Aisne and the forest of Villers-Cotterets. Before this blow was stopped on the 13th, the attackers had gained a considerable extent of ground, including the villages of Laversine, Coeuvres and St. Pierre-l'Aigle. These gains were important since they brought the Germans to the northern edge of the defensive position in Villers-Cotterets Forest, already closely pressed on the east. The French accordingly began counter attacks in this region to nullify the danger. On the 15th they captured Coeuvres and the territory to the north of that village. On the 17th and 18th they continued their attacks, recovering much of the disputed ground and considerably improving their position.

The heaviest German attack of the period outside the area of the Oise offensive was delivered on the night of June 18 against Rheims. The assaults began at nine o'clock in the evening after three hours of violent artillery preparation, and continued into the next day. The attack covered the entire front from west of the city clear around its northern side and well to the east. The attack against Rheims itself was made by three divisions which had orders to penetrate the positions regardless of losses. They were repulsed, however, with very heavy casualties as were all of the attacking troops. Southeast of Sillery, on the east front of Rheims, a small initial gain was made, but the French soon restored their lines.

On June 7 the British troops operating in the vicinity of Rheims had recaptured from the Germans the village of Bligny, about eight miles southwest of Rheims,

EUROPEAN WAR—Continued

together with the nearby hill of the same name. Shortly thereafter this section of the Allied line was turned over to an Italian force. On June 22 the Germans made a surprise attack against Mont de Bligny. They succeeded in temporarily rushing the position, but were promptly ejected by the Italians. The attempt was repeated on the night of the 23rd. This time the Germans suffered an immediate repulse.

The foothold on Belleau Wood which the Americans had secured on June 10 was extended on the 21st by advances both to the east and the north. The Germans still retained a strongly held position in the northwestern corner of the wood. This was taken by the Americans on the night of the 23rd. Just north of the wood the main German line ran along the crest of a ridge about two miles long. In the center of this ridge and commanding the whole of it is a high wooded knoll. This key point had been strongly fortified, many machine guns mounted and a garrison of 1200 men placed upon it. This knoll now became the American objective. After an all day's bombardment the hill was stormed on the night of the 25th. The enterprise was entirely successful. With few exceptions the whole garrison was killed, wounded or captured and fifty machine guns were taken.

There were no other actions of any importance in this region, tho minor fighting on a local scale was general. On other parts of the front there was little activity of sufficient interest to warrant mention, despite the fact that considerable energy was shown in the way of raids and local attacks at many places. On the night of June 10 the Australians advanced their lines about 700 yards on a front of 4000, capturing the spur overlooking Morlancourt and Sailly-Lauret. The Americans at Xivray, a few miles west of Seicheprey, in Lorraine, were attacked on June 16 by 600 German shock troops. The assaulting party broke into the village but were later thrown out in hand-to-hand fighting. On the preceding night the British took two miles of the German front line trenches north of Béthune. Many other lesser actions were mentioned in the despatches but none of them had any effect upon the general situation.

A mention of raiding activity in the Vosges about the middle of the month disclosed for the first time that American troops were on this front. It was later given out that a division of Americans had been occupying a sector in the Vosges since late in May. There are now six divisions of troops from the United States holding independent parts of the line.

The first two weeks of July were marked by an absence of all major operations on the western front. The Germans were evidently preparing for their next effort and made no attempts at offensive action. The Allies, on the other hand, continuing their policy of the latter part of June, undertook a number of local attacks, meeting with considerable success. There was a remarkable similarity between all of these minor affairs. In each, the assaulting troops quickly attained their objectives, apparently experiencing little difficulty in so doing. The fronts attacked and the depth of penetration were quite uniform. None of them were stopped short and none were carried very far. In every case an appreciable number of prisoners was taken, the Allied losses being slight. The purpose of the Allied command in making these attacks was probably a combination of the desire to improve their positions locally, to interfere as much as practicable with the German plans, and to gain all possible information concerning those plans.

On the night of July 1 American troops made a brilliant attack on the village of Vaux, taking the village and two patches of woodland, and cutting off a salient which the enemy held just north of the Marne. The advance was made on a front of a mile and a half to a depth of just under a mile. At the same time the French captured Hill 204 on the right of the Americans. Over 800 prisoners were taken in the two operations, and heavy casualties were inflicted on the Germans.

A surprise attack was delivered against the German lines just south of the Somme on the morning of July 4 by an Australian force aided by a detachment of Americans brigaded with them. Ground was gained to a depth of a mile and a half on a front of twice that distance. The gains included the village of Hamel, the trench system beyond it and the Vaire Wood. The whole action did not take over two hours and netted 1500 prisoners. This stroke left a triangular salient in the British lines west of Sailly-Laurette. The Australians attacked astride the Somme over a front of 3000 yards on the night of July 7 to remove this salient. The assault was entirely successful, the line being straightened out to correspond to the gains of the 4th.

On the 8th French troops delivered an attack in the region southwest of Soissons, near Longpont. Here the Germans held a strong position on a cleared ridge, supported by the fortified Chavigny Farm. The French broke thru on a front of nearly two miles for a gain of 1000 yards. Chavigny Farm and the ridges to the north and south were occupied. The positions thus reduced had formed a salient overlooking the chief eastern exits to the Retz Forest. Its removal added greatly to the security of the French lines to the west and southwest.

The French struck once more on the 9th, this time west of Antheuil, southeast of Montdidier. Here the German line was pierced on a two-and-one-half mile front. At some points the advance exceeded a mile in depth. It was announced at this time that during the minor operations since June 15 the French and American troops had captured 5400 prisoners, including 60 officers.

The advance near Longpont was resumed on the 10th, when further gains were made north of the Chavigny Farm, some quarries to the east were occupied, and the lines were pushed to the outskirts of Longpont and into the northern section of Corcy. The occupation of Corcy was completed on July 11, and the next day Longpont was taken. Another and more important operation on the 12th was the blow struck by the French on a three mile front north of Mailly-Raineval (eight miles northwest of Montdidier). Here the enemy positions were broken into for a mile and a quarter, and

the village of Castel together with several strongly fortified points in the line were captured.

There now came a sudden shift in the character of the fighting, brought about by the launching of the expected German offensive, which fell on the whole front from north of Châlons, in the Champagne, westward beyond Château-Thierry. Altho it had been expected that the Germans would once more take the offensive shortly, there was considerable surprise expressed by many commentators that this particular sector should have been selected for the purpose. The reason for the decision of the German General Staff appears fairly obvious, however.

The really vital part of the western front is, of course, the section from the Marne north to the Channel. All of the previous German offensives this year have been directed against this section. Even the drive south between Soissons and Rheims must be considered in this category, since, as has been previously commented upon in these reviews, the westward extension of that movement was the really important part of the operation. The Allies were naturally alive to the danger and threw in men on the critical front until it was much stronger than at any former time. It was doubtful if the Allies could be pushed back again here except at a prohibitive cost, at least before their attention had been first attracted to some other sector. If the offensive were switched to some new front, the acknowledgement of failure on the main front must be offset by a very considerable gain of territory. The most likely sector for such a purpose—for the introduction of the element of surprise and the promise of great results if successful—was undoubtedly in the Champagne. The supply lines of the Champagne sector were already disrupted by the advance to the Marne, placing the defenders at a disadvantage. If the line here could be broken Rheims must certainly fall. A greater advance would mean the cutting off of Verdun and would probably force the entire eastern Allied line to retire precipitately. It was no mean project, but it was destined to fail.

Shortly after midnight on the morning of July 15 the Germans opened a sudden and intense bombardment on the front from Massiges, northeast of Châlons, to Château-Thierry. The infantry attacks developed soon after daylight. The distribution of attacking troops seems to have been uniform, 10,000 men to the mile, except directly north of Rheims. Here the attack was perfunctory. The Germans had already experienced the strength of the defenses of Rheims, and the city must fall thru being outflanked if the rest of the offensive was successful. The Germans failed, however, to attain the surprise which has attended their previous offensives. It is stated from Paris that the blow had been foreseen, both as to time and place. The reception that was accorded it certainly seems to bear out this statement.

The attack really consisted of two parts, one east of Rheims and one west of that city. The battle to the east of Rheims, in the Champagne, went almost wholly against the Germans from the start. Toward the western end of this battle line the French fell back for short distances to more favorable defensive positions. Here they stopped, however, and the attackers were unable to advance a step farther, in spite of their desperate assaults. At no point did the Germans gain more than about four miles of territory without military value. After two or three days of costly but useless struggle, the attempt to advance was abandoned.

West of Rheims the Germans met with more success. The main pressure here took the form of an advance across the Marne River from Château-Thierry east to Dormans. The river line attacked was held by American troops from Château-Thierry as far as Mézy, southwest of Jaulgonne. The French occupied the south bank of the stream from Mézy eastward. The principal German crossing was made in the Jaulgonne bend of the Marne. Here the river runs around three sides of a sharp northward bend, leaving a small salient on the defenders' side against which the enemy could concentrate in overwhelming strength. To add to the Germans' advantage the southern bank of the Marne is low here so that the whole salient is commanded from the other shore. Naturally the assailants had little difficulty in forcing a crossing at this point. While establishing their main crossing here, the Germans made simultaneous attempts to cross at many other localities.

At Château-Thierry, the westernmost point where a crossing was attempted, the strong American fire caused the failure of every effort. Farther east, about Fossoy, the crossing was delayed for some hours by the gruelling punishment inflicted by the American machine gunners. About ten o'clock the Germans finally transferred a division to the south bank at heavy cost, establishing themselves close to the river, but were unable to advance farther. The American right was also driven back, and Mezy occupied. A number of crossings were effected on the portion of the river held by the French, after much delay and loss.

Shortly after noon the Americans counter-attacked and cleared the entire south bank of the Marne as far east as Mezy. This was a novel operation, as it has been the unvarying experience since the beginning of the trench warfare that it is impossible to hope for success in a counter attack so quickly after the initiation of a strong offensive. The French made no attempt at a counter effort. Instead they employed their usual elastic defense, falling back slowly and exacting the highest possible price for each enemy advance, but conserving their own strength. Taking advantage of the French policy, the Germans pushed forward to the general line Crezancy-St. Agnan-La Chapelle-Monthodon. At the same time other forces worked eastward along the south bank of the river, taking Dormans and reaching the outskirts of Mareuil, five miles beyond.

The German push to the south attained its maximum gain on the first day. Desperate fighting on the 16th failed to yield them anything in this direction, altho their gains were extended laterally to a slight degree. To the west they reoccupied Mezy, which had become untenable thru the German gains farther east. They also worked slowly eastward along the river, paying dearly for every advance.

The first day's attack between Rheims and the Marne had netted the assailants two to three miles along most

EUROPEAN WAR—Continued

of the front from the Marne to the Vesle. The Germans found themselves unable to push farther here after the first rush, try as they might. Conditions south of the Marne were becoming critical, however, and it was necessary to do something. Late on the 16th the French counterattacked on the front St. Agnan-La Chapelle-Monthodon, driving the Germans back to within two miles of the Marne and seizing the heights which commanded the river. In an effort to relieve the situation on the south bank, the Germans concentrated their assaults just north of the river with the idea of pushing east here, thus outflanking the French across the stream. Finding this beyond their powers, they once more transferred their attentions to a direct drive eastward along the south bank. In this movement they were more successful. Progress was slow and costly, but by constant pressure they gradually secured control of the south bank as far east as Oeuilly before other events forced the discontinuance of their attacks.

By the close of the third day of the offensive it was evident that the movement as a whole must be considered a costly failure. Experience has shown that a blow of this kind must meet with success in the beginning or not at all. If the defense manages to stop the drive in its first stages, there is little possibility for a successful renewal of the movement. The fighting had been the most costly to the assailants of any of the German offensives and they had far less to show for their losses.

There was, however, one element of the situation which boded ill for the French. The progress along the Marne constituted a distinct threat against Rheims. If it could not be stopped, the city would have to be evacuated, or at the best, its defenders would be at a continual disadvantage until von Boehm's forces were thrown back. The obvious method to accomplish this was by a frontal attack. Such a movement could hope to succeed only at great cost and offered no possibility of development if the Germans were finally forced north of the Marne. General Foch decided for the indirect method of compelling the Germans to retire by a threat at their communications thru an offensive from the western side of the Marne salient.

The Allied attack was begun on the morning of July 18 on a front from Fontenoy south to Belleau Wood, a distance of nearly thirty miles. The southern end of the attacking line was composed of American troops. There were also some Americans operating with the French farther north. The offensive came as a great surprise to the Germans. It was started in a heavy rainstorm and high wind. Conditions were such that accurate artillery work and airplane observation were very difficult. This fact was taken advantage of by the Allied command to bring up unobserved a large number of tanks, especially the small, fast type recently developed by the French.

In beginning the attack the tanks were sent forward with little preliminary artillery fire, taking the Germans completely by surprise. The infantry, advancing behind the tanks, easily overcame the resistance that was offered, making large captures of men and guns. The greatest gain the first day was made on the northern end of the attack, where General Mangin's army took the heights dominating Soissons from the west and southwest, and reached the Crise River, beyond the Soissons-Château-Thierry road. The advance was somewhat less farther south, tapering down to about two miles along the Ourcq. South of the Ourcq General de Goutte's army, largely American, pressed forward three to four miles in some places.

On the 19th the Germans counter-attacked fiercely in an effort to re-establish their lines, but failed everywhere. Their concentrations were particularly heavy in the vicinity of Soissons, which seemed to be the center of their greatest anxiety. Altho they were unable to drive the French from the plateaus dominating the city, they did succeed in taking up sufficiently strong lines with their increased forces to prevent General Mangin from making any further appreciable gains. This section of the line remained practically fixed for the remainder of the month. Elsewhere the Franco-American force continued to advance. Along the Ourcq and south of that stream they pushed ahead some two miles on the 19th.

It became evident that the German troops south of the Marne must fall back lest they find their lines cut and a retreat impossible. The retirement of von Boehm's forces began early on the 20th. French and American troops immediately attacked all along the front south of the Marne. The German forces were extricated only with great difficulty and with heavy losses. By nightfall of the 20th the Germans had entirely abandoned the southern bank of the river except for a small bridgehead at Jaulgonne.

While the retreat from south of the Marne was going on, the Allied forces northwest of Château-Thierry were pushing ahead steadily. Their progress left that town in an awkward salient and it was evacuated on the 21st. The attack continued to develop toward the east and northeast. By the 24th the Allies were in Jaulgonne, their line running generally northwest from that town to Armentières on the Ourcq. The advance was strenuously opposed and the Germans made numerous counter attacks to check the French and Americans. The Allies were not to be stopped, however, and forged ahead in the face of the fiercest opposition.

In the meantime the east front of the salient from Rheims to the Marne was attacked by the Allied troops, the French in this sector being assisted by British and Italian divisions. Progress was made at several points along the line, but the gains were of much less extent than those in the region of the main attack. The action here was purely secondary, designed to occupy the attention of the enemy and prevent the despatch of German troops to the other side of the salient.

The primary purpose of the Allied offensive had now been secured. The threat against Rheims was ended for the present and the Germans had been forced to retire north of the Marne once more. But the success which was attending the movement opened a possibility for much greater results—the elimination of the entire Marne salient—and the Allies pressed on without cessation. On July 27 the Germans withdrew

from their last hold on the Marne River, the five mile stretch from Verneuil to Châtillon, falling back to the north.

It appears to have been the German intention to take up a new defensive line along the north bank of the Ourcq and thence eastward past Ville-en-Tardenois, thru a wooded, hilly country which offered good opportunities for defense. This line was probably not to be held permanently, but merely long enough to give time for the removal of the vast stores of supplies in rear, and for the preparation of a permanent position along the Vesle or the Aisne. But the Allies acted too promptly for the full success of this scheme. Before the eastern end of the new German line could be occupied, the French and Americans were across the Ourcq and had reached the high ground north and east of Fère-en-Tardenois.

This last Allied success provoked a series of the most determined counter-attacks on the part of the enemy. For the better part of two days an intense struggle raged along this front. Finally the Allied artillery came up and the advance was resumed about mid-day on the 30th. Relatively little ground was gained directly north of Fère, but an advance of about two miles was made just east of the town. In the Ville-en-Tardenois section of the line the Allies did not press the enemy hard. Instead they contented themselves with occupying the territory abandoned in the retreat, with no attempt to hurry the movement. There was no necessity for strong action here as the Germans were forced to fall back in conjunction with their troops farther west, lest a sudden break in the line there would leave them in a pocket from which they could not escape.

Meanwhile an important advance had been made east of the Soissons-Château-Thierry highway just to the north of the Ourcq. In this region the French, on July 29, captured the villages of Cugny and Grand Rozoy, together with the height known as the Butte de Chalmont. This gave the Allies command of a long stretch of the Ourcq Valley and an unbroken view of the territory within the German lines for many miles to the northeast. These gains were somewhat extended in the course of the 30th. On the 31st there was little fighting, the battle consisting mainly of artillery exchanges. The Allies were getting ready for a continuation of their advance in strength, while the Germans were taking advantage of the respite to prepare for the next move.

At the end of July the line of contact between the opposing armies across the southern end of the salient ran approximately as follows: Bligny, Ville-en-Tardenois, Villers-Agron, Cierges, Sergy, Seringes, Saponay, Grand Rozoy, where it joined the line running south from Soissons. This latter line extended practically along the Soissons-Château-Thierry road to the hills southwest of Soissons. The line as it now exists is wholly temporary. There is no doubt that the Germans will fall back farther. The only question is whether they will attempt to establish their new posiions behind the Vesle or north of the Aisne. It now appears probable that the more southerly of the two alternative lines will be chosen if the Allies can be stopped there.

Outside the theater of greatest activity, in the Marne salient, there were very few operations of any importance on the western front during the latter half of July. In the Vosges mountains southwest of Munster American troops penetrated the German positions for 600 yards on July 20. On the 18th the Australians south of the Somme advanced their lines southeast of Villers-Bretonneux on a front of a mile. A week later the Germans attacked at the same place, but were repulsed. The British made a gain south of Hébuterne on July 19, piercing the German positions for a width of a mile. During the next few days these gains were somewhat extended.

The French troops in the Montdidier sector had unusual success in a local attack on July 25, when they captured Mailly-Raineval, Sauvillers and Aubvillers, with 1850 prisoners. The Germans were apparently taken by surprise by the French advance, as little opposition was encountered. The occupation of this area considerably strengthened the front before Amiens, giving the French a better line close behind the Avre River and further attenuating the German salient.

In Flanders the British have retaken the villages of Meteren and Merris. Several heavy German counter attacks here failed to recover the lost positions. On the 29th the Australian troops penetrated the opposing lines south of Morlancourt for 500 yards on a front of 4000 yards. The enemy's reaction was weak and easily overcome.

General Gouraud's army in the Champagne had started a series of local attacks, as soon as the German pressure lessened their front, for the purpose of reoccupying some of the territory from which the French had withdrawn upon the initiation of the German offensive on the 15th. The attacks covered a wide front and much of the ground in question was regained. It was announced on July 26 that to the east of Suippes an advance of about 1500 meters had been made to the general line of St. Hilare Grand, Sounin and Le Mesnil-les-Hurlus. In the region of the Main de Massiges, which was reconquered, the former line was reoccupied in its entirety.

The first few days of August witnessed the successful termination of the Allied attempt to straighten out the line across the former Marne salient. On Aug 1 a concerted assault by the French and Americans overran important enemy positions northwest and east of Fère-en-Tardenois. By nightfall the French had reached Hill 205, the high point on the Oulchy-Fismes road, while the Americans farther east pushed thru Meunière Wood. The pressure was now kept up unremittingly, the attacking front being broadened to include the whole line from Rheims to Soissons. General Mangin's French army, aided by some British troops, forced its way across the Crise south of Soissons, and pushed rapidly eastward. On the evening of the 2nd his troops entered Soissons, which the enemy had abandoned under the threat of being surrounded. About the same time his leading elements reached the Vesle east of Soissons. Meantime the French and Americans in the center had been advanc-

EUROPEAN WAR—Continued

ing northward in pursuit of the retreating Germans, who made no attempt to stand after the Ourcq line was definitely pierced.

On the 3rd the Allies gained the south bank of the Vesle along practically its entire length. The the Vesle and the Aisne, just west of the mouth of the former, as well as a few bridgeheads on the south bank of the Vesle in its upper reaches. Otherwise they retired to the north side of the stream. Their bridgeheads were reduced during the course of the next few days.

The question now arose whether the Allies should continue their rushing tactics in an attempt to drive the Germans behind the Aisne. It soon became evident, however, that any such assault would be extremely costly. The German line had now been straightened out until it could no longer be attacked from the flank as formerly. The river is small, but offers no favorable points for crossing in force as it runs in an approximately straight line, with no large bends. It is moreover commanded thruout its length by the heights on its north side, which the enemy seemed to be holding in strength, supported by a considerable concentration of artillery. To add to the natural difficulties, rain had fallen in sufficient quantities to raise the stream above its normal level and to soften the flats along its course.

Small Allied forces effected crossings of the Vesle on Aug 4 in order to test the German strength. These parties were soon halted by a vigorous resistance, but managed to maintain themselves on the north bank. A few days later part of them were again thrown back of the river by German attacks, but counter blows restored the positions with some slight increases. The Allies gained and held a stretch of the north bank about four miles in length, extending from Bazoches to Fismette across the river from Fismes. All serious attempts to advance were now abandoned as events farther west indicated that the Germans might be forced to fall back without the necessity for direct assaults. There was, however, more or less confused fighting thruout the remainder of the month, mostly brought on by fruitless German attacks upon the Allied foothold on the north bank. When there was no active infantry fighting the artillery kept the opposing lines deluged with shell fire and gas. There was also much bombing from airplanes.

In the meantime the Germans in the Amiens salient had made some local retirements, abandoning ground of little value unless an offensive were contemplated, and falling back to lines more easily defensible. These withdrawals were made on the German's own initiative, and not under the stress of an attack, but they were destined to be the forerunners of momentous events. The movements were doubtless induced by the desire to shorten and strengthen the lines in view of the necessity that had arisen for sending many of the reserves from the armies of Crown Prince Rupprecht to the assistance of the sorely pressed Prussian Crown Prince. Many divisions from the north had already been identified by the Allies in the Vesle sector.

The first of the German retirements took place on Aug 2, when a small salient north of Albert was evacuated and the lines drawn back behind the Ancre. Farther south a part of the territory west of the Avre River was similarly given up beginning on Aug 4. The French and British followed the retiring enemy, hastening the withdrawal of his rear guards but not attacking in force.

Altho not particularly important in themselves, the German withdrawals furnished a clear indication of the opinions that their high command entertained concerning the general situation. No more public advertisement could have been made that all idea of resumption of the offensive in these regions had been abandoned. Foch's stroke south of the Vesle had forced a redistribution of the enemy's reserves fatal to the prosecution of his campaign, and necessitated the employment in the front line of troops intended for quite another purpose. Altho the Allies were no stronger than the Germans in men available for use at the front, if indeed the latter were not still in the preponderance, it was evident that the initiative was now definitely with Marshal Foch. The Allied Generalissimo is not a man to surrender such an opportunity without the most urgent necessity. His whole idea of successful warfare—what he has taught and written for years—is the employment of the offensive, pushed as strongly and as continuously as possible. He was accordingly quick to take advantage of the evidences of a weakening in the German hold on the Amiens salient.

On Aug 8 the Allies attacked the German lines east of Amiens, the main front of assault extending from the Somme River southward to Hargicourt on the Avre. On the left, Rawlinson's Fourth British Army operated from the Somme to a point south of the Luce. From there on the attack was extended by the First French Army under GGeneral Debeney. At first the greatest gains were achieved by the British. By the close of the 8th General Rawlinson's troops had reached the line Beaucourt, Caix, Framerville and Chipilly. On their right the French had won the crossings of the Avre and had pushed a little to the east of Moreuil. There can be no doubt that the Germans were greatly surprised by the Allied attack. The artillery preparation was severe but unusually brief. The advance started at 5 a.m., the infantry waves being preceded by a large number of tanks of both the heavy and the "whippet" types. The first German positions were overrun quickly, and in the open fighting which followed the defenders seemed unable to recover from their demoralization.

The 9th saw a continuation of the rapid advance by the British. Thus far the French had met with rather more opposition than their Allies, and had moreover not been pushing their attacks with the same determination. The advance of the British on the north had necessarily caused the enemy forces before the French to retire, but the heavy pressure on their front seemed to be lacking. The reason for this now became apparent. Late on the 9th the French began a fierce assault on the German lines southeast of Montdidier, heading in a northeasterly direction. The rapid

advance of the British had drawn to their section of the line most of the available German reserves in adjacent parts of the sector. The new French attack was thus enabled to push forward with great speed. About mid-day on the 10th the French movement was completed by joining up with the eastward push farther north. The apex of the salient about Montdidier was thus completely cut off. The city fell into the hands of the French without a struggle. With it there were captured several thousand prisoners and great quantities of supplies, especially ammunition which had been stored here as a reserve for much of the contiguous line.

The Allies now began to widen the front of attack, with the idea of taking advantage of any considerable shifting of German reserves toward the sectors first threatened and at the same time preventing the concentration of all the reserves on any one small front. On the evening of Aug 9 British and American troops stormed Morlancourt and the high ground to its southeast, in the angle north of the Somme, between that stream and the Ancre. The next day, while both British and French continued to press ahead along the whole front previously developed, the latter began a new attack on the extreme right, in the old Matz battlefield, meeting with complete success.

By the close of the third day of the offensive the Allies had registered notable gains all along the line. The front ran in general Morlancourt-Chipilly-Raincourt - Lihons - Bouchoir - Andechy - La Boissière - Fescamps-Orvillers-Sorel-Cury-Mareuil. The resistance offered to the advance of the British had now stiffened greatly. For several days there was practically no change on their portion of the line. The Germans delivered a number of counter attacks, all of which were repulsed but which served to hold up the British advance. Farther south, however, the French continued to drive ahead, slowly but steadily closing in on Roye and Lassigny. Their advance west of the Oise uncovered Ribecourt, which the Germans abandoned on the 14th. This opened the road up the Oise toward Noyon, and the French immediately started to move in that direction.

There now began a series of local attacks for limited objectives along the whole French front. These involved a great deal of severe fighting and the successive actions would ordinarily be worthy of extended comment. But the month was so full of activity that they can be touched upon but briefly. Suffice it to say that this was a period of steady pressure with moderate gains. Altho each advance was comparatively slight, the cumulative effect of the progress, which was maintained day after day, was to place all of the supporting points of the German defensive line thru Chaulnes, Roye and Lassigny in a precarious position.

The first of these towns to fall was Lassigny. By means of their successive advances the French had pressed close in to Lassigny on the north and west, and had begun the difficult task of forcing a way thru the broken country to the south, when a new factor put in an appearance. On the evening of Aug 18 the French once more extended their active front to the right, when General Mangin's troops initiated an attack east of the Oise on a front of about nine miles. The assault followed the now generally accepted system of a short bombardment preceding an advance by a force of tanks to prepare the way for the infantry. It was successful everywhere. By nightfall the French had captured the plateau west of Nampcel and were well on their way toward Carlepont. On the next day General Mangin continued his advance, villages and wooded tracts falling rapidly into his hands. The notable inadequacy of the defense in this sector is said to have been due to the failure of the German "depth defense" system. In this instance the advanced machine gunners offered such slight opposition that the French were in the main defensive positions before the garrisons were prepared for them.

Encouraged by his success of the first two days, General Mangin now enlarged the scale of his attack by including all the front from the Oise to the Aisne, a distance of about fifteen and one-half miles. The French advance continued almost uninterruptedly. By the 21st they were over the crest of the ridges in the angle between the Oise, Aisne and Ailette, and were pushing down the slopes to the north and northeast.

In conformity with the movement east of the Oise, and materially assisted thereby, the French to the west of the river likewise advanced. The enemy troops holding Lassigny finally became seriously threatened with being surrounded, and the city was evacuated. The fall of Lassigny removed that obstacle on the route to Noyon, which was already under fire from General Mangin's artillery south of the Oise. It also uncovered the flank of the German positions to the north. Little immediate advantage of this latter result of their success was taken by the French, but they at once moved against Noyon. A protracted struggle for the city ensued. One by one the French captured its outer defenses, however, and finally took Noyon itself on the 29th. From then until the end of the month they worked slowly north and east from the city, meeting a most determined resistance.

General Mangin's army had reached the Ailette on the 22nd. The next day a foothold was secured on the right bank of the river at Champs. Attention was now turned to pushing eastward in the rough country north of Soissons. Progress was slow but each day showed some advance. The evident intention in this operation was to secure positions from which a rapid movement might be started eastward along the Aisne, outflanking the Germans on the Vesle. The operation was continuing at the close of the month. There were also signs of a push on the north side of the Ailette, since the bridgehead at Champs was being extended as the month ended. American troops appeared north of Soissons on the 28th, when they reported on the line west of Juvigny. They took this town the next day and continued on to the east in conjunction with the French on their flanks.

The British had met with a sharp check in their attempts to capture Roye and Chaulnes, in the center of the battle area. It would appear that there were

EUROPEAN WAR—Continued

not enough British troops available here to throw in the necessary reinforcements to counterbalance the German reserves. The taking over by the Americans of a considerable portion of the Vosges front, and the shortening of the line due to the elimination of the Montdidier salient had, however, left the French with some troops disengaged. Some time after the middle of August the French took over the line to a point north of Chaulnes. No serious offensive movement was undertaken on any part of this section of the front until the relief was completed, apparently about Aug 25. The Germans seem to have been under the impression that the attack here had been stopped by their defense, and were apparently not entirely prepared for a resumption of the offensive.

The French began their attack against Roye on the 26th, when they took Fresnoy-les-Roye, three miles to the north, and reached the Roye-Péronne road. They also pushed up to within two miles of the town on the west. The next day they captured Roye and advanced some two miles farther east, occupying a number of outlying villages. Chaulnes fell before the French advance on the 28th. The Germans now made a precipitate retirement on a front of about eighteen miles, from Cizancourt, seven miles south of Péronne, as far south as Noyon. The French followed their retreating enemy closely. By the evening of the 28th they had advanced an almost uniform distance of six miles along the whole front, being established on the west bank of the Somme and of the Canal du Nord between the Somme and the Oise. The lines in this section underwent little farther change during the rest of the month. The Somme has proved to be none too effective a barrier in the past, however, and the positions are now threatened by the Allied successes on both flanks of this part of the line. In consequence the belief is becoming general that the Germans will before long retire to the old Hindenburg line, making their real attempt to stop the Allies there.

One of the prime reasons for this belief is found in the great success which attended the British attacks between Albert and Arras while the events just chronicled were proceeding on the French portion of the front. Beginning on Aug 14 the Germans had instituted a withdrawal on the front from Beaumont-Hamel to Bucquoy, north of the Ancre. This retirement proceeded slowly for several days, the British patrols keeping in touch with the movement, which gradually spread out to the north. When it became evident that the Germans were really abandoning a considerable section of their advanced lines, Marshal Haig decided to attack, believing that the enemy would probably be found in an unfavorable situation for meeting the blow.

The new drive was made by the Third Army under General Byng, on the ten mile front from the Ancre to the neighborhood of Moyenneville. Attacking under cover of a dense fog on the morning of Aug 21, the British quickly overran the first positions and pushed on to the east. Little difficulty was experienced until the line of the Albert-Arras railroad was reached. Here the enemy resisted fiercely, but by the end of the day the positions had been forced in a number of places. The fact that nearly 3000 prisoners were taken shows that, tho General von Below may not have been holding his front lines in great strength, they were far from abandoned.

On the 22nd the British did not attempt to press ahead in the direction of the previous day's advance, but shifted their attack to the front from Albert south to Bray, on the Somme. Albert was captured and a gain of about two miles was made all along the line assaulted. Meanwhile German counter attacks beat fruitlessly against the British positions along the Albert-Arras railroad.

Beginning with Aug 23 the offensive was pressed by all the British troops from the Somme to the Sensée. Day after day the advance continued. Sometimes the gains were very slight at some points, but always the line of contact moved to the east. The advance was most rapid on the northern flank, where the British had employed the principle of extending their attack laterally after a great part of the enemy's reserves had been committed to the defense of the front previously attacked. Here in the region of the Sensée the British swept forward thru Ervillers, Hamelincourt, Boyelles and Boiry-Besquerelle before the defense could organize its resistance. The next day the progress was continued, despite the most determined opposition, to St. Lefer and Henin-sur-Cojeul.

On the 26th another northward extension of the operations was begun, this time along both sides of the Scarpe. Here, too, the British met with immediate success. By the end of the second day they had crossed the Hindenburg line, and were farther east than they had ever been in this region. The gains here were increased, tho slowly, until the end of August, when the line on the enemy side of the old positions ran thru Oppy, Plouvain, Hamblain-les-Prés, Eterpigny, Haucourt and Hendicourt. The last named town, together with Bullecourt, which has before proved a stumbling block in the path of the British, fell on the 30th. On the 31st a German counter attack threw the British back to the western outskirts of both places, but there were as yet no indications that the attackers had more than temporarily stopped.

The British advance west of Bapaume and Combles had meanwhile been going on steadily. The Germans threw in many fresh troops here, evidently electing to employ the bulk of their reserves in this sector at the expense of the positions farther north. The attackers were not to be denied, however. Slowly they closed in on Bapaume from the west, while north of the city they advanced as far as Vaux-Vrancourt, four miles to the northeast. Bapaume itself finally was entered on the 29th. Thereupon the Germans to the south fell back to a line extending north from Péronne, which they held at the close of the month.

This situation cannot obtain for long. In connection with the French movement against Chaulnes, the British had advanced eastward along the Somme, covering the left flank of their allies. The last of August they reached the great bend of the river, just west of Péronne, and secured crossings there and at Brie, farther south. They were also close to Péronne on

the north bank of the Somme. It is a foregone conclusion that the city must fall shortly, in which event the line both to the north and south must again retire. There can be little doubt that this time the retirement will be to the Hindenburg line, essentially to the positions from which the Germans launched their great offensive which was to end the war this year.

We have now seen the almost total elimination of two of the salients established by the Germans in 1918. The third one, the Lys salient south of Ypres, is also in a fair way to disappear. On Aug 5 the Germans withdrew from a small area on the southern face of this salient, in a manner similar to their retirement east of Amiens. The British followed close on the heels of the retiring Germans, and by the 9th they had advanced about 2000 yards on the whole front from the Lawe River to the Bourre River, northwest of Merville. There now followed a few days of patrol engagements and raids by both sides on various parts of the salient, none of which had much effect. About a week later the Germans withdrew slightly on the western side of the salient. The British now attacked in an effort to hasten the movement. On the 18th they advanced from 1000 to 2000 yards on a four-mile front between Bailleul and Vieux Berquin. The next day the attacking front was increased to about six miles. Merville was taken and the front advanced to the north and south road thru that city. For the remainder of the month there were no great single changes in the situation but the salient was steadily reduced in size, largely thru voluntary withdrawals, tho the British occasionally made local attacks when the occasion seemed favorable to inflict loss upon the enemy at slight cost.

Most of the ground recovered by the British was on the western side, but the northern front began to move in toward the end of the month. Bailleul was entered by the British on Aug 30 and Kemmel fell the next day. As the month closed the line ran south from Bailleul to the mouth of the Lawe River. South of the Lys the British had crossed the Lawe and were advancing toward the La Bassée-Estaires road. The movement appeared to be still under way.

An official statement from Paris announces that "In the course of their offensive from July 18 to August 31 the armies of the Allies have taken 128,302 prisoners, including 2674 officers, and have captured 2069 guns, 1734 mine throwers, 13783 machine guns, and a considerable quantity of munitions, supplies and materials of all kinds." It was further stated that the captures on the French front included 75,900 prisoners and 700 guns.

The fighting on the western front during September consisted at first of a series of rather disconnected, but far from unrelated, Allied attacks upon different parts of the German line, followed toward the end of the month by a general pressure against most of the front from Verdun to the Channel. In none of these actions has it appeared to be Marshal Foch's intention to break thru the German lines and secure a decision, the method adopted by the German leaders when they began their offensive operations on Mar 21. Such a plan of campaign, altho possible of adoption now that the Allies have the initiative and the preponderance in numbers, would have involved a heavy concentration of strength on a relatively short front with a consequent inflexiility in the continuation of the offensive. The Germans were still too strong to make an overwhelming success probable, and the definite checking of any one great push would leave the Allies much worse off than when they started.

Marshal Foch therefore acted upon a policy looking rather to an ultimate certainty of success than to possible immediate overthrow of the German power. Striking at critical points on the long battle-line he inflicted a series of local defeats upon the enemy, forcing them to disseminate their reserves to widely separated localities and making easier the Allied advance in other sections. In addition to the very considerable gains of territory secured by the Allies in the pursuance of this line of strategy, there were other results, both practical and psychological. Seeing themselves driven back at the many points of Allied pressure, the German soldiers are coming to think in terms of defeat. Their morale is distinctly lowering as the Allied successes continue, which in turn will make further gains the easier. Aside from the psychological results of these German defeats, the heavy losses that have been inflicted upon them is increasing the disparity in numbers in favor of the Allies, already sufficiently noticeable. Due to the improvement in offensive tactics and to the apparent lessening in the fighting power of the German Army, the Allies have inflicted materially greater losses upon the enemy than they have themselves sustained. There is no intention to intimate that the Germans have stopped fighting. They are still resisting the Allied thrusts fiercely and are far from being a force that need not be reckoned with. But the fine edge of the German military machine seems to be blunted. The comparative ease with which the Allies have recently taken positions against which former attempts cost them dear, and the great number of prisoners captured in every action, show this clearly. In the last ten weeks more than four times as many German prisoners have been taken as in the entire battle of the Somme, which lasted nearly five months.

At the end of August the the Allies were pushing hardest at the ends of the long German retiring front on the west—the British east of Arras and the French in the broken country between the Oise and the Aisne. They were also exerting pressure to a lesser degree on the line between these points. The first days of September saw notable success in all of these fields.

In the north the British scored a truly remarkable triumph. The Germans here were ensconced in their old positions, strengthened thruout a lengthy occupation. The British advance in the region of the Sensée in the last days of August had already attracted attention to this sector. The Germans had concentrated heavily to oppose the advance of the British, and General von Boehn, who had recently been entrusted with the defense of the region, made strenuous efforts to reverse the rôles of the two armies. His counter attacks threw the British out of Hendecourt and Bullecourt, but the British declined to assume a defensive

EUROPEAN WAR—Continued

attitude, and finally re-established their ascendency with the occupation of the two disputed towns late on Sept 1. Elsewhere the Germans did not attain even this temporary success, their counter-offensive being checked in the inception.

The British struck again in force on Sept 2 on both sides of the Arras-Cambrai road. It is stated that the Germans had formed a line of unusual density on this front, numbering eleven divisions to 8000 yards. They were nevertheless thrown back violently, losing over 10,000 prisoners. The attacking troops burst their way thru the Quéant-Drocourt switch line to a maximum depth of over four miles. The advance was continued the next day, the Germans being in no condition to make a determined stand. By the night of the 3rd the British were on the line L'Ecluse, Rumaucourt, Baralle, Beaumetz-les-Cambrai and Ytrès. They were now within six miles of Douai at the northern end of their new positions and less than eight miles from Cambrai farther south. The Germans, however, had been greatly reinforced and were in a position to offer a formidable defense. It was the part of wisdom, therefore, in view of the general Allied policy, to stop the offensive in this region for the time being. This the British proceeded to do after they had widened their new salient on its southern side during the next two days to include Moeuvres, Hermies, Neuville-Bourjonval and Bertincourt.

Turning now to the south, the area in which the French were operating was not such that they could use the rushing tactics employed by the British east of Arras. The ground between the Oise and the Aisne is very rough, much of it moreover being covered with extensive forests. The French accordingly pushed ahead by means of successive attacks upon different points. The employment of offensive tactics of this kind gave to the enemy many favorable opportunities for the delivery of counter attacks. The Germans took full advantage of this situation. In some cases the French were held up, and even driven back temporarily, but in the main they forged steadily toward the east. On Sept 3 they reached Clamecy and Bucy-le-Long, south of the Ailette, while north of the river they gained the outskirts of Coucy-le-Chateau and Jumencourt.

The Germans were becoming worried about their positions along the Vesle River, as the advance of General Mangin's Franco-American forces threatened to embarrass a satisfactory handling of a retirement to the Chemin des Dames behind the Aisne. It was becoming increasingly evident that such a withdrawal would be necessary before long and it was to the advantage of the Germans to start it before too late. A decrease in the German strength along the Vesle showed that they were beginning to fall back. Mangin now rested the northern flank of his troops and struck heavily eastward along the Aisne. Early on the 4th he took Moncel and that night captured Missy, two miles farther to the east and within striking distance of Fort de Condé and the important crossing at Vailly. The same night the Germans began their withdrawal from the western end of the Vesle line.

During the next two days the French occupied Condé, north of the Aisne, and Vieil Arcy, on the south bank, while American troops followed the retreating enemy to the Aisne at Giennes and Villers-en-Prayères. The retirement extended only as far east as Fismes at this time. Beyond that point the Germans held doggedly to their positions along the Vesle. The actions in this section now languished while the French developed a new blow farther north in the direction of La Fère.

After some days of stubborn fighting the French broke the resistance of the enemy north of the Oise, and on Sept 4 reached a line west of Ham, extending thence thru Freniches, Guiscard, Grandru and Apilly, five miles east of Noyon. They also took Marizelle, east of the Ailette. The French advance west and northwest of La Fère was steady for several days. The Germans fought determined rearguard actions and counter attacked fiercely at numerous points where they were being pressed too closely, but made no real effort to stand. By the 10th the French were essentially in the old positions before La Fère, their line extending from there northward thru Fort Liez, Montescourt, Essigny-le-Grand and Castres to the west of St. Quentin. South of the Oise General Mangin had meantime been making notable gains. On the 5th he entered Folembray, Coucy-le-Chateau and Coucy-la-Ville. The next day his troops advanced to Petit Barisis after heavy fighting in the broken, wooded country roundabout. On the 7th Barisis, to the east of the Lower Coucy Forest, was occupied, together with Aulers and Bassoles to the southeast. The operations in this region were ended with the capture, on Sept 10, of Servais, four miles south of La Fère. The French were now farther east here than at any former time.

While the French had been thus driving forward on La Fère and St. Quentin, the British on their left had not been idle. Péronne had been captured by a brilliant stroke on Sept 1. The captors of the city pushed on for several miles to the east, the troops on their right and left conforming to the movement. This movement was not continued immediately, but on the 5th the troops south of Péronne advanced, following up the retreat of the Germans induced by the French successes farther south. The advance was now taken up by the forces in front of Péronne and those farther north to fill in the gap to the south of the new Cambrai salient.

Considerable resistance was encountered by the troops on the left of the advancing line. This was overcome, however, and by the 7th the front ran north and south thru the junction of Roisel, seven miles east of Péronne. On the extreme left the British were in Havrincourt Wood. For the next few days there were relatively few changes in the situation, altho the British made a number of slight advances, especially in and about Havrincourt Wood, where there was severe fighting, and in the vicinity of St. Quentin. On the 9th they advanced, in the course of a fierce struggle, over a four mile front southward from Havrincourt Wood to Pezières, capturing Gouzeaucourt Wood and the old British trenches on the high ground overlooking the village of Gouzeaucourt. Heavy German counter

attacks delivered in this section during the next two days were unsuccessful. The operations all along this front were now within the area which had been strongly entrenched in 1917. This increased facility for defense, together with the very considerable reinforcements which had been received by the Germans, accounted for the slowing up of the British progress. Unfavorable weather conditions tended in the same direction.

The British were not content to let the matter rest here, however. Their days were busily engaged in getting ready to renew the attack on a scale commensurate with the difficulties confronting them, meanwhile improving their positions by local actions. On Sept 12 important progress was made in the direction of Cambrai by an advance of half a mile on a front of three and a half miles. The villages of Trescault, Moeuvres and Havrincourt were taken, the lines being pushed across the Canal du Nord at the last named point. On the same day the threat against St. Quentin was accentuated by the capture of Vermand, Vendelles and Attilly. This latter movement was supported by the French on the immediate right, who pushed their lines as far as the Holnon-Salvy road, only three miles from St. Quentin. There were no more noteworthy actions in the next few days during the continuation of the British policy of establishing themselves in their old lines facing the German defenses. Southwest of Cambrai the Germans attacked repeatedly at Moeuvres, the point of farthest British advance along the Bapaume-Cambrai road. On the 17th the British were finally driven back to the western edge of the village, but regained it on the 30th.

The slackening of the British and French efforts on the west did not mean that the Germans were free from trouble, even temporarily. The attitude of the troops in the areas of lessening activity remained distinctly threatening, requiring the presence of all the reserves that had been sent there, while an entirely new Allied stroke fell far to the east, in the sudden American attack upon the St. Mihiel salient. This salient jutting into the front south of Verdun with its apex at the barrier fort and village of St. Mihiel is too well known to followers of the war to require any description. The tactical plan for the operation of reducing the salient was simple in the extreme. It consisted essentially of two drives along the base of the salient from points on its sides, the forces from the two sides to meet in the center, thus cutting off the entire wedge. Altho simple in its conception, it was the type of undertaking that required careful preparation and the most perfect co-ordination in its execution.

"A main attack on the south side of the salient was to strike northward on a ten mile front west of the Moselle. A similar but less heavy attack was to force its way eastward on the western face. On the south the attack was aimed to pass over the Woevre plain, cross the wood at Thiaucourt and Pannes, and move thence northwestward upon Vigneulles. From the west the advance starting at and south of Combres had to traverse the eastern edge of the Meuse heights, penetrate several miles of wooded territory and reach Vigneulles from the northwest. This town lay ten miles northeast of the tip of the salient, and the chord passing thru it and connecting the two faces measured some twelve miles. Speed in reaching the point of junction formed the first requirement for success. Thereby only could any great number of the enemy be cut off from retreat."

The attacking infantry went forward on both faces of the salient at 5 o'clock in the morning, after an intense preliminary artillery bombardment of four hours. The troops on the southern face had the easier country to traverse and at first made the more rapid progress, being assisted in their advance by tanks. By two o'clock in the afternoon the Americans had gained possession of the villages of Nonsard, Pannes and Thiaucourt. Nightfall found them well into the woods on the way to Vigneulles. The advance was continued in the dark and at three o'clock the next morning Vigneulles was reached.

On the western face the attackers encountered serious resistance in the vicinity of Combres and St. Remy. It was not until just before dark that they established themselves here. The resistance in their front now lessened materially, however, and they advanced rapidly to the southeast thru the forest of Montagne. Despite its poor start this force gained the western edge of Vigneulles at midnight, three hours before the troops from the main attacking front.

The salient had now been cut off, but there was still a considerable area toward St. Mihiel, together with the German forces which it held, not yet secured. The clearing out of this area was left to the troops in rear and the forces on the new line advanced toward the northeast. By the close of the 13th the line ran thru Herbeuville, Thillot, Hattonville, St. Benoit and Jaulny. Little difficulty was experienced in overrunning the country in rear of the line and capturing the Germans remaining there. St. Mihiel itself was first entered by French troops, a few divisions of which were stationed at the apex of the salient, some of them assisting in the opening stages of the attack on the western face.

For the next three or four days the Americans continued to work slowly to the northeast all along the base of the old salient. Several German counter attacks were repulsed, but these appear to have been delivered rather with the idea of preventing a too rapid advance on the part of the Americans than for the purpose of recovering ground previously lost. By the 17th the new line had become practically stabilized on the front Manheulles, Pintheville, St. Hilaire, Doncourt, Woel, Haumont, north of Jaulny, to the Moselle north of Vandières. This represented a gain of from two to three miles beyond the positions reached immediately after the first blow. The front now settled down once more into the usual semi-quiet of an "inactive sector."

This movement as a whole is especially important as the first of any size planned and executed by the Americans. The completeness of the success is a most hopeful augury as to what may be looked for in the future. It has been announced that over 20,000 prisoners and in the neighborhood of 200 guns were

EUROPEAN WAR—Continued

captured. The Germans appear to have anticipated the attack and to have already begun the evacuation of the salient. They erred, however, in not beginning their withdrawal quickly enough, and as a result lost a very considerable percentage of the garrison of the salient, as well as large quantities of supplies. Besides the material that was taken by the Americans, the Germans destroyed a great deal which they were unable to remove.

The passing of the St. Mihiel salient marks a distinct epoch in the war. It had existed for four years —in fact the American attack occurred on the fourth anniversary of its establishment. In 1915 the French struggled desperately to eliminate it but the most they were at that time able to accomplish was an advance of a mile or so on the southern face after prolonged effort and at frightful cost. So long as the Germans retained their aggressive spirit the salient remained a serious threat against France. There was always the danger that a sudden strong thrust based upon St. Mihiel might cut off Verdun and open the way into central France. Its existence also precluded any Allied advance into Lorraine and made dangerous an offensive northward thru the Champagne country. With the final loss of the initiative by the Germans, the possession of the salient was no longer such a powerful offensive weapon in their hands, but it still had defensive value. With its elimination the Allied commander is much freer than formerly to develop his strategy in eastern France. One of the valuable results of the American success was the freeing of the Verdun-Nancy railroad, the lack of which has been a continual source of annoyance to the French. The road was found undamaged and ready for immediate use.

Before the Americans had finished the exploitation of their stroke, General Mangin resumed his interrupted advance north of Soissons, beginning on Sept 14. On that day and the next the French advanced their line between the Ailette and the Aisne about a mile. They captured Mont des Singes, south of the Ailette, the plateau east of Vauxaillon, the Laffaux mill, Nanteuil-la-Rosse, Sancy, Allemant and Vailly, on the Aisne. The Germans under von Carlowitz resisted this movement desperately, fearing for the flanks of their lines both to the east and to the north. Not content with a stationary defense, they launched repeated fierce counter attacks at different points in an effort to stop the French. That the action was costing the Germans dear was shown by the great number of bodies found by the French in their advance. The latter also took 3500 prisoners. By the end of the second day the German resistance had become so strong that the French halted. They improved their positions in spots by slight local gains, but attempted no general advance. They held fast in the face of counter attacks, however.

The center of interest now shifted to the north about St. Quentin once more. On the 17th the British took the village of Holnon, northwest of St. Quentin. The next morning they delivered a general attack on a front of 16 miles from Holnon north to Gouzeaucourt, while the French extended the assaulting line six miles south from Holnon to Essigny-le-Grand. The movement was successful thruout. The heights south of Gouzeaucourt were seized and the outskirts of Villers-Guislain reached. Farther south a number of villages were taken, the most important being Epehy, Hargicourt, Villeret, Pontru and Fresnoy-le-Petit, the last only four miles from St. Quentin. The French reached the outskirts of Francilly-Selency, took Savy Wood and Fontaine-les-Clercs, and advanced to the southern edge of Contescourt. The British right and center had penetrated the enemy's defensive line of 1917 on the first day of this attack. On the 19th they gained the advanced positions of the whole German fortified line from Pontru to Gouzeaucourt, while the French captured Contescourt. At this time the Allies had taken 8000 prisoners and 50 guns.

From now on until the end of the month the Allies pressed steadily upon St. Quentin. There were no great single gains, but each day saw the lines drawn nearer to the city. At the last of September it was closely surrounded on the north, west and south, while the French were even then in the edge of the city proper. Its fall was momentarily expected. The later phases of the movement against St. Quentin were a part of concerted pressure along the whole German line as far east as Verdun which characterized the closing days of September. Altho nearly all of this prolonged front was more or less affected in this general movement, it was really made up of five simultaneous attacks. These were delivered in the Ypres sector, on the Cambrai-St. Quentin front, north of Soissons, between the Aisne and the Vesle, and in eastern Champagne. They will be considered in order from left to right.

The attack in Belgian Flanders was begun on Sept 28 on an eight mile front from just south of Dixmude to a point north of Ypres. This is the first important operation in which the Belgians have taken part for over a year. The Germans are reported to have been using this portion of the front as a "rest camp" recently, sending there divisions which had been so badly shaken elsewhere as to require reorganization. They paid dearly for their policy. The Belgians quickly overran the first and second enemy lines and pushed ahead. Their greatest gains were made on the right. The strongly fortified Houthulst Forest was completly occupied and at the close of the first day the line ran thru Woumen, Pierkenshoek, Schaep, Baillie and Broodseynde. The British on the immediate right of the Belgians kept pace with the advance.

On the 29th the Allied forces continued their success on a much larger scale. The whole of Passchendaele Ridge was taken. Despite violent counter-attacks the Belgians advanced and captured Dixmude, Zarren, Terrest, Staden, Westroosbeke and Moorslede. At nightfall they were attacking on the Roulers-Menin road. To the south the British, broadening the front of advance secured equally astonishing results. During the first part of the month the Germans had slowly given up more of the Lys salient, the

flattening out of which had begun in August. The British were still, however, to the west of the old Messines-Wytschaete positions. They now assaulted on this front in conjunction with the operation farther north. They soon overran the Messines-Wytschaete Ridge and pressed on. The enemy resisted stubbornly in a vain effort to defend the approaches to the river Lys, and suffered heavy losses. At the end of the day the British had gone beyond a line from the eastern edge of Ploegsteert Wood thru Gaepaerte, St. Tenbriein, Terhard and Dadizeele. On the 30th General Plumer's army reached the Lys from Warneton to Wervicq and neared Gheluwelt, while the Belgians, supported by a contingent of French troops, pushed their line two kilometers east of Zarren, captured Stadensett and crossed the Roulers-Menin road.

The success which had attended this operation was truly remarkable. In three days a greater advance had been made at slight cost than the British had been able to secure in 1917 after months of effort and at a heavy price. During the first two days of the advance over 9000 prisoners and 200 guns, many of heavy caliber, were taken. About two-thirds of these fell to the Belgians. Already the important towns of Roulers and Menin are closely pressed, while the movement as a whole is beginning to threaten the German hold on the Belgian coast to the north and on Lille to the south.

The drive against the Cambrai front was started on the 27th by the First British Army under General Horne and the Third, commanded by General Byng. It extended for about twenty miles south from the Sensée River. Important inroads into the German positions were made on the first day. Among the points captured were Sauchy-Lestree, Bourlon, Anneux, Beaucamp and Flesquières. On the extreme right American troops, two divisions of which cooperated with the British, entered the enemy defenses southwest of Le Catelet. On the 28th Marcoing was taken and a bridgehead established on the east bank of the canal opposite that place, while the west bank was cleared as far north as Folie Wood. Raillencourt and Sailly near the Arras-Cambrai road were taken by the Canadians. South of Marcoing the British captured Gouzeaucourt and the heights known as Highland and Welsh Ridges.

The next day the battle developed southward, the troops in this region attacking across the Scheldt Canal. The British took Bellenglise, Lehaucourt and Magny-la-Fosse, while the Americans on their left captured Bellicourt and Nauroy. In the center Villers-Guislain and La Vacquerie fell to New Zealand troops. Just south of Cambrai the attackers entered the villages of Masnières and Les Rues Vertes. In the meantime the British northwest of Cambrai had taken Palleul and Aubencheul-au-Bac. On Sept 30 the Germans counter attacked strongly on the northern portion of the line, and the British were temporarily stopped. Farther south, however, they captured Gonnelieu and reached the west bank of the Scheldt Canal from Vendhuille northward. The positions gained the day before east of the canal were extended. The month closed with no indications that the offensive in this sector was at an end. The closing in of the French on St. Quentin in connection with this operation has already been mentioned.

General Mangin's army suddenly attacked once more north of the Aisne on Sept 28. Passing thru Jouy and Aizy the French occupied on that day all of the Malmaison Plateau with the fort of the same name. On the 29th they took Pargny-Filain and Ostel, cleared the Forest of Pinon and reached the Ailette in that region as well as east of Chavignon. The next day a force of Italian troops operating in this sector stormed the village of Soupir. The French are now well onto the western end of the Chemin des Dames. The German positions to the east are under observation and fire.

The French began an advance between the Aisne and the Vesle on Sept 30. Reports as to the results attained on the first day are too vague to give any details of the operation at this time. It would appear, however, that this is the beginning of an attempt to clear the Germans from the remaining territory south of the Aisne, and especially from the plateau of St. Thierry, which commands Rheims.

The Allied attack in the Champagne and Meuse regions was launched on Sept 26 by the First American Army and Gouraud's Fourth French Army. The total front affected was about fifty miles in length, extending from Auberive, on the Suippe east of Rheims, eastward to the Meuse. The fields of activity of the two armies were separated by the Argonne forest, in which no strong offensive was attempted. The American section of the front covered the twenty miles between the Argonne and the Meuse River. On the first day of the attack the Americans advanced a maximum distance of seven miles, reaching the general line thru Dannevoux, Septsarges and Cheppy. From now on the German resistance was most determined but the attacking troops pushed on slowly. By nightfall of the 28th they had reached the southern outskirts of Brieulles and Exermont at the two extremities of the line, which ran approximately straight across between these points. The next day Brieulles and Exermont fell, while the center advanced north of Cierges and Nantillois. On the 30th the general progress was halted by violent German counter attacks. A few slight gains were made nevertheless, especially east of Exermont. In the Argonne Forest, the section of the line which had been left behind in the rapid advance over the less difficult country to the east was gradually pushing ahead.

The initial gains of the French to the west of the Argonne were less marked than those of the Americans. This was more than made up for, however, as the movement progressed. The Fourth Army has held this sector of the front ever since the Battle of the Marne. They were consequently familiar with every foot of it. The enemy attempted to apply Gouraud's own maneuver of meeting the attack by an initial retirement to a strongly held line in rear, by means of which they had been so severely punished when their offensive of July 15 in this region was checked. The French were not to be caught in

EUROPEAN WAR—Continued

the trap, however. They contented themslves with occupying the abandoned German positions and regaining contact with the new lines, until fully prepared to meet the altered conditions. The strong fortifications in their front were then brilliantly stormed in the face of the fiercest opposition. Among the many points taken—well known after the years of fighting over this ground—were the Navarin Farm, Butte de Souain, Butte de Tahure, Butte de Mesnil and the villages of Ripont and Rouvroy. On the 27th most of the advance was on the right where the Bois de l'Echelle and the village of Cernay were captured. Good progress was made the next day along most of the front. In the left center the railroad from Somme-Py eastward was passed and that village occupied. The heights northeast of Auberive were secured on the 29th, as well as positions near Boucon-vil, just west of the Argonne, which commanded the junction at Challerange. The advance was continuing on Sept 30, when the French took Aure and fought their way into Monthois. The fighting thruout this operation has been of the fiercest description. The Germans defended their successive positions with determination and counter-attacked repeatedly at every opportunity. So far, however, the French have continued to make good progress, and it does not appear that the movement is in any likelihood of being stopped for some time.

It has been quite generally assumed by commenters that Marshal Foch's intention in the widely extended operations of the closing days of September is to pinch off the entire great salient from Verdun to the sea. It is probably too early to say definitely whether his plan is really as ambitious as that or not. Only the events of the next month can tell. Such a conception, especially when put into execution at this time with the weather favorable for campaigning almost at an end, could only be based upon a supreme belief in the present overwhelming superiority of the Allied troops, both materially and morally. Whatever be the truth as to the ultimate purpose in the launching of the general offensive, there can be no doubt that it has already achieved remarkable results. The German positions, strengthened after years of occupation, have been deeply penetrated on broad fronts at many vital points. The German plan of settling themselves in their secure and comfortable winter quarters, which have served them so well in the past, while they endeavored to secure an acceptable peace, has been rudely upset. Instead the Allied troops are now occupying the former German shelters in many places, while the former occupants are being pushed back steadily toward their own frontier, still, however, far distant. One interesting result of the recent Allied advances is that not a single French Department is now wholly in German hands.

From the beginning of the Allied offensive operations in the middle of July to Sept 30, the Allies captured 5518 officers, 248,949 men, 3068 cannon and over 23,000 machine, besides vast quantities of other materials. Of these totals rather more than half were taken during the last twenty days of September.

The close of the month of September saw in progress Marshal Foch's greatest offensive. The front of attack aggregated about 120 miles, with five principal points of pressure: (1) north and east of Ypres; (2) on the Cambrai-St. Quentin front; (3) north of the Aisne; (4) on the Aisne, the Vesle, and the Suippe; and (5) the wide front from eastern Champagne thru the Argonne to the left bank of the Meuse. Altho the offensives on all these fronts were intimately related to each other, it is more convenient to follow the operations separately, in order to preserve the continuity of the account.

The Ypres Front

The general offensive on this front started on Sept 28, and by the 30th the Belgians and French had captured the Houthulst Wood and the Passchendaele ridge, had crossed the Roulers-Menin road, and had forced their way close to Roulers. The British army under General Plumer had reached the Lys from Warneton to Wervicq. On Oct 1 the British crossed the Lys between Comines and Wervicq and captured Ledegham on the Roulers-Menin Railway. The Belgians captured Oostniewkerke west of Roulers. On Oct 3 the Belgians, French, and British drew nearer to Roulers. Fires indicated preparations of the enemy to withdraw. On Oct 2 the enemy began a voluntary retirement in the whole region from Armentières to Lens. During the next few days, the French and Belgians reached the outskirts of Roulers, when evidences of enemy withdrawal were observed. The British followed up their crossing of the Lys, and drew nearer to Turcoing. The German withdrawal allowed the British to occupy Armentières and Lens. A British containing attack was made on the front from Lens to Arras, making progress toward Douai.

On Oct 14 the Belgians, French, and British launched an attack on a 12-mile front from the Handzaeme Canal to the Menin Road. The Belgians captured Cortemarch, the French captured Roulers, and the British reached Menin and Wervicq, penetrating to the edge of Courtrai on their left. Further progress was made on the 15th.

On the 16th, notwithstanding stormy weather, the British, French, and Belgians launched an attack over a front of 31 miles from Dixmude to the Lys, penetrating to an average depth of three and one-half miles. The Belgians crossed the Yser north of Dixmude, occupied Schooreeke, and captured Thourout. The British crossed the Lys and pushed several miles beyond Menin on the right bank, Menin itself being captured. The French captured Lichtervelde and Ardoye. Twenty villages were delivered from the Germans. 12,000 prisoners and 100 guns were captured.

The progress realized on the Ypres front compelled the abandonment of Lille, and this largest French city in German hands was occupied by the British without resistance on Oct 16.

The German retirement in Flanders now became general. The abandonment of Lille on Oct 16 was followed by the withdrawal from Douai on the 17th, and from Roubaix and Turcoing on the 18th, all of

which were promptly occupied by the British. Accompanying this retrograde movement, the Germans also abandoned the whole of the Belgian coast, withdrawing to the line of the Lys from Ghent to near Courtrai and thence to the Scheldt at Tournai and Denain. From Ghent, the new line ran northward to the Holland frontier. This withdrawal was skilfully conducted with comparatively small loss of matériel.

Following up this withdrawal, the Belgians and French captured Thielt on Oct 20, and then advanced to the Lys at Denynge. Two crossings of the Lys were captured after vigorous resistance. 1100 prisoners were taken in these operations.

Oct 21, the British forced a crossing of the Scheldt at Pecqs, north of Courtrai.

The month closed with the Allies occupying a line following generally the Scheldt River from Denain to beyond Tournai, thence to the Lys east of Courtrai, following the line of the Lys to near Ghent and thence to the Holland frontier. The gains had yielded possession of the important cities of Lille, Roubaix, Turcoing, Courtrai, Roulers and Bruges. An even greater moral gain was the possession of the Belgian coast with the famous U-boat base at Zeebrugge.

The operations in this sector now died down, probably because of the difficulty experienced by the Allies in following up the retirement of the Germans in the low country, and their inability to organize immediately the means of further attack upon a front largely protected by formidable water barriers.

The Cambrai-St. Quentin Front

The inauguration of the general attack on the Cambrai-St. Quentin front by the 1st and 3rd British Armies under Gens. Horne and Byng and an American force under Maj.-Gen. Read on Sept 27 was followed by bitter fighting until the close of the month, during which the Germans counter-attacked with great violence. The line had been established about two miles west of Cambrai, continuing thence south along the general line of the canal to St. Quentin. The canal had been crossed by the British and Americans at several points. Fighting was in progress all along the line.

At this juncture, Gen. Debeney's French army, which had prepared the way by seizing Urvillers and Cerizy, attacked St. Quentin from the west on Oct 1 with complete success, occupying that portion of the city lying west of the canal. Heavy street fighting was necessary to clear out the Germans. On Oct 2, the southeastern suburb was taken.

During the next few days the British, by heavy fighting gradually pushed their lines forward. On Oct 3 an attack by infantry and tanks was made on a front of eight miles from Sequehart to the Scheldt Canal north of Bony. It penetrated the German trench lines between Fonsomme and Beaurevoir. 4000 prisoners were captured. The Germans counter-attacked heavily the following day and regained part of the ground. including Beaurevoir and Montbrehain. The struggle continued in this area thru two more days. The apparent object of the enemy was to gain the time necessary to withdraw from Cambrai.

On Oct 8, the British 3rd and 4th Armies and an American force, under Maj.-Gen. Lewis attacked on a 20-mile front between Cambrai and St. Quentin. The night was stormy and assembly of troops difficult. The assault was launched in a heavy rain, but the weather cleared as the attack progressed. The operations were completely successful.

The American forces captured Beaucourt and Prémont after heavy fighting. Immediately to the north the British gained Serain, Malincourt, and the trenches west of Walincourt. To the south the French captured Fontaine-Utertre and Rouvray. The average gain over the whole front was about three miles.

The same day, Oct 8, a movement was begun against the line north of Cambrai. The Canadians captured Ramillies and the canal crossings to the northeast. The fighting of this day yielded the British over 10,000 prisoners and the French 1200. Over 100 guns were taken.

On Oct 9, the British entered Cambrai. The city was seriously damaged by the Germans before evacuating it. The result of the week's fighting was possession of this city and a general advance over the whole front south to St. Quentin. The whole of the Hindenburg line for a length of over 35 miles from Arras to St. Quentin had been captured.

Now followed a readjustment of the line over the whole front from Cambrai as far as Rethel on the Aisne. The Germans abandoned Laon, La Fère, and the heights of St. Gobain. All of these were taken possession of by the French on Oct 13.

The result of these operations was the expulsion of the enemy from a long line of carefully constructed defenses. The Germans, defending themselves successfully on the flanks, managed to escape without serious loss of prisoners or matériel. In following up this retirement, the French encountered heavy resistance in the angle between the Serre and the Oise Rivers.

The German positions in front of Valenciennes held against strong British attacks for several days. Severe fighting occurred along the Selle River. After these preliminaries the British, in conjunction with an American force, delivered on Oct 17, a heavy attack along the upper Selle and southward to the vicinity of Solesmes and Le Cateau. This attack was supported by a French attack further south. Heavy fighting followed on this front for the next two days, ground being gained steadily against the most determined resistance. On Oct. 20, a frontal attack was made along the Selle, in which a crossing was forced in spite of its high stage due to recent heavy rains. The attacks of these three days yielded about 7000 prisoners.

The occupation of ground east of the Selle shook the German hold on Valenciennes. The western suburbs were reached on Oct 21. Moving past the Raismes forest, the British reached the Scheldt north of Valenciennes. The western suburbs of Valenciennes were entered on Oct 23, but the enemy stubbornly defended the city. By breaking the canal bank northeast of the city, a considerable area was flooded and further progress of the British in that direction

EUROPEAN WAR—Continued

blocked. North of Valenciennes the British were held up at the Scheldt, a formidable barrier.

South of the city, flanking operations were carried forward on Oct 23 and 24, and the line advanced at many points. 7000 prisoners were taken. On the 25th, the advance reached the line of the Valenciennes-Quesnoy ralroad. The Germans fell back behind the Rhonelle, the last of the streams barring the way to Valenciennes from the south. The great forest of Mormal, 40 square miles in extent, operated as a bar to any further advance south of Valenciennes.

The month thus closed with the British in the outskirts of Valenciennes, but with their further advance checked by formidable obstacles north and south of the city.

The line extended from the western edge of Valenciennes southeastward to the western edge of the great Mormal Forest, thence generally southward along the Canal de la Sambre to the Oise.

North of the Aisne

In the area between St. Quentin and the Aisne, the French army of Gen. Mangin had, by the end of September, fought its way forward to the Malmaison position south of Laon. The line followed the old Hindenburg position past La Fère and Moy to St. Quentin. Little occurred on the front north of the Aisne for some days other than a general pressure against a gradually failing defense. The stubbornly defended positions between Harly and Neuville-St. Amand east of St. Quentin, were captured Oct 9. As a result of progress north of Reims, the defense of the Laon salient was shaken. French and Italian troops pushed forward against the Oise-Aisne canal line and found it weakly held. Following up this advantage, the whole of the Chemin des Dames ridge was occupied on Oct 11 and 12. The St. Gobain heights were abandoned by the Germans, and Laon, La Fère, and the St. Gobain area were occupied without fighting. Following up this retirement the Germans were encountered in strength in the angle between the Oise and the Serre.

Pressure upon this salient of the German line began on Oct 18 with an attack by the French 1st Army on the forest of Audigny. This forest and the surrounding villages were captured wth 1800 prisoners. The operation gained command of the bend of the Oise near Guise.

Persistent but minor efforts now began against the area between the Serre and the Oise. A bridgehead at the confluence of these two rivers had been captured. Steady but small gains secured control of the east bank of the Oise as far as Ribemont by the 19th, with corresponding progress along the Serre.

South of the Serre, an intrenched line extending eastward several miles to the marshes near Sissonne, was attacked by the French and Italians on Oct 19. Two lines of trenches were carried, and an advance made to the Serre. Here the Germans offered resistance sufficient to prevent further progress in the next two days. On Oct 23 and 24, the French crossed the canal leading northward from the Oise at Grand Verly. In the Serre-Oise angle they reached the Feronelles brook. Further east the French broke across the Souche River at Brazicourt, near its junction with the Serre. This threatened to gain the road northeast to Froidmont.

On Oct 24, the French 1st Army, operating on the Oise front, forced the Germans back five miles on a fifteen mile front on both sides of Guise, at the bend of the Oise. The Germans defended Guise vigorously and managed to hold the town. On the Serre, Gen. Mangin's army captured Mortier and gained ground eastward as far as Château Porcien, on the Aisne. Severe fighting continued on this front for the next few days, tho without special features. The operations of Oct 24-6 netted about 7000 prisoners. A severe action was fought west of Bannogne on Oct 29 and 30. Considerable ground was gained on a 7-mile front, and 850 prisoners were captured.

The Aisne-Vesle-Suippe Front

In an attack begun on Sept 30, between the Aisne and the Vesle, a French army achieved considerable success. In the fighting on Sept 30 and Oct 1, the villages of Revilloi, Romain, Montigny, Meurival, and Ventelay and the plateau of St. Thierry were captured, with 3600 prisoners. The Germans then began falling back northward over the whole front as far as Reims, expedited by French pressure north of that city. Loivre was captured Oct 3, thereby carrying the line back practically to the Aisne. A crossing of the Aisne at Berry-au-Bac was forced.

On Oct 5, vigorous pressure was resumed on the whole front of the Aisne canal, northwest of Reims, which was crossed at several points. The outskirts of Bermericourt were reached. More than 2500 prisoners and 31 guns were captured. Five of the guns were of 210 mm. caliber.

On Oct 7, the French attacks spread eastward along the Suippe, where very stubborn resistance was encountered. Particularly lively fighting occurred near Bertricourt. The following day the outskirts of Condé-sur-Suippe were reached, Isles-sur-Suippe penetrated, and Bazancourt captured in spite of determined resistance and violent counter-attacks by the enemy.

Oct 11, further progress was made and crossings of the Suippe effected between St. Etienne and Boult-sur-Suippe, at Warmeriville, Vandetre, and St. Masmes.

Champagne-Argonne-Meuse Front

By the end of September, the American attacks on the front between the Argonne and the Meuse had been brought to a standstill, after a bound forward of about seven miles on the first day, and some small subsequent gains. The line reached was abreast of Malancourt.

West of the Argonne the French initial gains had been less marked, but by the end of September they had occupied Aure, Monthois, and Mamaux.

Binarville was captured on Oct 1. Challerange and the line some miles to the west were captured on Oct 2, in spite of heavy resistance and desperate counter-attacks by the enemy.

West of the Argonne, considerable progress was

made north of Somme-Py, and Mt. Blanc was captured Oct 4. Severe fighting occurred around Autry and Lancon for several days.

East of the Argonne, the American 1st Army met with most determined opposition. Chatel, Chehery, Exermont, and Cornay were captured. The latter point is four miles southeast of Grand Pré, and was captured Oct 8. Further progress toward Grand Pré was impossible at this time.

East of the Meuse, troops of the American 1st Army, in conjunction with French troops, began an attack east and northeast of Verdun on Oct 8. Haumont, Beaumont, Brahant, and Consenvoye were captured, penetrating beyond the line held by the Germans when they began their great attack on Verdun in 1916. 3000 prisoners were captured this date. Heavy counter-attacks were repulsed the following day. This attack was then allowed to die down.

Vouziers was captured by the French on Oct 12. The enemy had defended with desperation the Kriemhild Stellung, covering the Grand Pré gap thru the Argonne, but the capture of Vouziers compromised this defense. It took several days of very heavy fighting to complete the capture of the Gap. The attack culminated on Oct 15 and 16, when the American troops took St. Juvin and captured Grand Pré itself. The position was defended with great stubbornness by picked troops. Notwithstanding the difficulties of the terrain, the American troops would not be denied. Operations east of the Meuse resulted in the capture of the Bois de la Grande Montagne.

On Oct 18, the French advanced eastward from Vouziers in an attack against the region north of Grand Pré. Several villages, including Vandry, were captured. Violent counter-attacks by the enemy ensued immediately, and continued persistently for several days. Positions changed hands repeatedly, but in the end the French maintained their gains.

East of the Argonne, there was further heavy fighting by the American 1st Army. Bantheville was captured on Oct 18, and Brieulles on the 23d, thus bringing the line to a general level with Grand Pré. Violent efforts were made by the enemy to recapture Grand Pré. At one time the town was entered, but it was recaptured by the Americans on Oct 23.

From this date until the end of the month, the Americans were engaged in constant and severe fighting with steady tho small gains. Numerous violent counter-attacks were made by the Germans. East of the Meuse, Hill 360 was captured on Oct 25, after several days of severe fighting. Belleau Wood was captured and finally held against repeated counter-attacks. West of the Meuse, Aincreville was captured on Oct. 29. No further gains of importance were made during the month.

The strenuous defense of the Germans in the Argonne area is explained by the fact that the advance in this region was a direct threat against the important railway line leading eastward from Mezières and Sedan, one of the main lines by which any general withdrawal from northern France must be accomplished. It is reported that as soon as the Americans reached ground within about 13 miles of this railway line, long-range guns were immediately brought into action against the railway in an effort to interrupt its use.

From Verdun south to the Swiss frontier the front remained quiescent during the entire month.

EASTERN THEATER

The anarchical condition of affairs in Russia has continued and has even grown worse if possible. There is now open civil war in the southern portion of the country. The Ukrainians and the Don Cossacks under Kaledines are in revolt against the Bolsheviki. They have refused to permit coal and food to be sent from the territory under their control into northern Russia. As the section thus affected is the most important producing region of Russia, the Bolsheviki are endeavoring to invade the south and seize Odessa and the food supplies. The exact situation is difficult to determine but much fierce fighting has been reported. It is stated that the Bolsheviki have organized and armed large numbers of German prisoners of war to assist them in their struggle against their antagonists.

Peace negotiations between the Bolsheviki and the Central Powers have been carried on actively, but little progress has resulted. The first commissioners of Germany and Russia met on Dec 2, 1917. Three days later a ten days' armistice was declared and before its expiration this was extended until Jan 14. It was agreed that during this interval of the suspension of hostilities (which was to continue indefinitely unless advance notice were given by one of the contracting parties) an attempt should be made to arrive at terms of a permanent peace. It was further specified that there should be no transference of troops or regrouping of forces on either side "excepting those begun before the agreement was signed." This last provision practically left the Germans free to shift forces as they pleased, which they have proceeded to do.

The peace negotiations were begun on Dec 22 at Brest-Litovsk. The Russian delegates presented their terms of peace as soon as the conference had been formally organized. The proposals of the Bolsheviki provided for:

First, no compulsory annexation of territory taken during the war, but speedy evacuation of such territory; second, restoration of independence to all nations that had lost it thru the fortunes of war; third, national groups not independent before the war to decide by referendum whether they shall become independent or give their allegiance to some power; fourth, in any territory occupied by mixed nationalities the rights of the minorities to be defended by laws insuring educational freedom and administrative autonomy; fifth, no belligerent to pay indemnities but all belligerents to contribute to a special fund from which private persons shall be compensated for losses incident to the war; sixth, the same principles to be applicable to colonies as to the parent countries; seventh, no boycotting of one country by another after the war.

The Central Powers made their answer to these proposals on Christmas Day thru Count Czernin, Austro-Hungarian Foreign Minister. He stated that the Central Powers were ready to conclude a general

EUROPEAN WAR—Continued

peace which should be just to all belligerents. It was believed that such a peace could be secured practically on the basis proposed by Russia, if all belligerents should subscribe to them in good faith. The principles of no forcible annexations and no indemnities were approved, as was that of restoration of political independence to those nations which had been overrun. The declaration against economic war after the war was also declared to be in accord with the desires of the Central Powers. The third and fourth clauses of the Russian proposals, relating to subject nationalities, treated of problems which could not be solved internationally, but must be dealt with by each Government and its peoples according to their constitutions. The return of Germany's colonies was stated to be an essential part of the German peace terms. which could not be renounced under any circumstances. In place of the establishment of a joint fund for the reimbursement of war losses it was proposed that each belligerent should pay for the cost of maintaining its own prisoners of war and for losses to enemy aliens in its territories due to illegal acts. The evacuation of occupied territories it was proposed to leave to the peace treaty. It is understood that Germany will insist that the disposition of the portion of Russia now held by her armies be decided by a vote of the inhabitants. As such a vote would be under German jurisdiction and most of the inhabitants except German sympathizers have left, the result could hardly be in doubt.

At the close of the month it appeared doubtful as to just what the outcome of the negotiations might be. The Russian delegates were reported to be insistent upon their proposals in full. The Bolsheviki leaders declared that they would not accept offensive terms of peace from the Germans but would raise the nation to take up the struggle once more. In Russia's present state, however, it is not probable that she could go ahead with the war whatever the circumstances.

In the vast amount of more or less conflicting information which has come out of Russia during the past month there is comparatively little which seems to bear directly upon the war as a whole, and which, therefore, properly comes within the scope of this review.

The peace conference at Brest-Litovsk, which adjourned after the announcement of the general peace terms of the Central Powers, reconvened on Jan 10. It was then announced that the terms offered by the Central Powers had been withdrawn as they had not met with a favorable response from the Allies. During the recess the Petrograd government had come to an agreement with the Ukrainian Rada concerning the recognition of an autonomous government for the Ukraine, and the delegates from the new state were admitted to the conference. Very little was accomplished by the peace negotiators during the month. After a great deal of generalizing the Germans finally presented the demand that Russia should relinquish Poland, Courland, Lithuania, and Esthonia to Germany, and that all territory south of Brest-Litovsk should be surrendered to Ukrainia. The Russian delegates unanimously decided not to consider these terms, and nothing more was done during the month. The Bolshevik leaders express themselves as satisfied that it will be impossible to arrive at acceptable terms of peace, and talk of resuming the war, tho there are no indications of their ability to do so. It has been stated, however, that they are organizing new forces in rear, and are moving the undependable troops from the front lines.

Tho the negotiations with the Bolsheviki were interrupted, at least temporarily, the Austrians continued to confer with the representatives of Ukrainia. A separate peace with this portion of the former Russian Empire is of the greatest importance to Austria. The terms would undoubtedly provide for the supply to the Central Powers of a large part of Ukrainia's abundant store of grain, cattle and metals. Moreover, Rumania would thus be entirely cut off from her Allies and would have to accept whatever terms of peace she could get. The question is somewhat complicated, however, by the fact that the Ukrainian Rada at Kiev is not unopposed. A faction following the precepts of the Petrograd Bolsheviki claims to be in control of the eastern portion of the Ukraine, about Kharkov, and to represent the true wishes of the people as opposed to the government set up by the *bourgeoisie* at Kiev. Fighting between the two factions is going on, and the Bolsheviki element has also sent delegates to Brest-Litovsk. Count Czernin is thus placed in a difficult position. Should he continue to negotiate with the delegation from Kiev he runs the risk of offending the Petrograd Bolsheviki, ruining the remaining chances for a peace in that quarter. If, on the other hand, he recognizes the Kharkov representatives, he at once alienates those from Kiev and loses the possibility of splitting Russia and of obtaining supplies immediately. It is to the advantage of the Central Powers that Ukrainia should be entirely free from Petrograd's influence. It also appears that the Kiev faction is in the ascendancy at present. It is probable, therefore, that negotiations with the Kiev authorities will be continued, since peace with Ukrainia is more important than peace with Petrograd under existing conditions.

Hostilities have broken out between the Bolsheviki and the Rumanians. The trouble appears to have been originated by Bolshevik agitators attempting to spread their doctrines amongst the Rumanian armies. To this the Rumanian authorities objected, and the disturbers were suppressed. Petrograd supported the Bolsheviki emissaries, demanding that they be left free to continue their work. One thing led to another, and it was not long before there was active warfare between the former allies. The exact situation is not clear. There has been fighting in Moldavia, where some of the Russian troops who were co-operating with the Rumanians have been attempting to cut their way thru to join their com-

patriots to the north. Two Russian divisions have been disarmed by the Rumanians, who seem to be supported by a part of the Russian forces. General Tscherbatcheff, the commander of the Russian troops in Rumania, has been outlawed by the Bolsheviki because he co-operated with the Rumanians in disarming Russian organizations.

The conflict has developed into a struggle for the possession of Bessarabia, the Russian province just east of Rumania, from which it is separated by the Pruth River. The population of Bessarabia is largely Rumanian. Russia seized the province in 1878, but it has always been regarded by the Rumanians as properly belonging to them, and they have never given up hopes of ultimately regaining it. There are now other and more immediate reasons why Rumania must have control of Bessarabia. It is there that the munition depots and reserve supplies furnished by the Allies for the use of the troops in Moldavia are located. With these supplies in their possession the Rumanians may be able to maintain themselves for some time; without them their position is hopeless. Rumanian troops have crossed the Pruth and have seized the section of Bessarabia containing the depots. It appears that they are endeavoring to extend their control over the entire province.

The negotiations between the Central Powers and the representatives of the Ukraine have finally borne fruit in the first peace treaty of the great war. That such an event was a probability had been foreshadowed by the trend of affairs in preceding weeks, as well as by the knowledge that a peace in this quarter would be greatly to the advantage of the Central Powers, and of the newly formed nation also.

The treaty was signed at 2 o'clock on the morning of Feb 9. After declaring the termination of the state of war between the nations of the Quadruple Alliance and the Ukrainian People's Republic, the treaty defines the western boundary of the new nation. As originally prescribed, there was included in Ukrainia a considerable section of Poland. This brought forth so much acrimonious comment from Poles everywhere, and particularly from Polish citizens of the Central Empires, that a supplementary agreement was later reached by which Ukrainia surrendered claim to this territory. The treaty provides for the evacuation of occupied territory, the establishment of diplomatic and consular relations, and the resumption of commerce on a free trade basis. Reimbursement of war costs and indemnities is renounced. Supplementary treaties signed at the same time cover the restoration of consular relations, of state treaties and of civil law, indemnification for civil damages, the exchange of prisoners of war and interned civilians, care of burial plots of those fallen in enemy territory, and treatment of merchant vessels in enemy hands.

If the Ukrainian People's Republic is able to control all the territory to which it lays claim, it will cover a greater area than either France or Germany, and will have about 28,000,000 inhabitants. The great advantage which the peace will bring to the Central Powers lies in the invaluable economic aid which it will give them. Ukrainia comprises only one-sixth of European Russia but contains 32 per cent of all the farming land. Before the war it produced one-third of Russia's grain, much of which was exported. It contained one-third of the cattle and half of the smaller livestock of all Russia. Tho the production has fallen off during the war, there are great stores of supplies on hand, needing only a reorganization of the distribution system to make them available. The new nation is also rich in iron and coal, tho this is of less present importance to the Central Powers since they already control the deposits of Belgium and northern France.

On Feb 10, the next day after the conclusion of peace by the Ukraine, the head of the Russian delegation at the Brest-Litovsk conference announced the cessation of the war on the part of the Bolsheviki. It was stated that "while Russia was desisting from signing a formal peace treaty, it declared the state of war to be ended with Germany, Austria-Hungary, Turkey and Bulgaria, simultaneously giving orders for complete demobilization of Russian forces on all fronts." A later despatch gave the information that the order for the demobilization had been suspended temporarily as regards a considerable part of the army, but that the former announcement was correct in other respects.

This Russian policy of "no war but no peace" was not satisfactory to Germany. The German leaders insisted that they must have a definite acceptance of their terms. The situation in Ukrainia was also disquieting. The Bolsheviki were carrying on a determined struggle with the forces of the Kiev Rada, in which the latter were steadily losing ground. It began to appear that the Central Powers were in a fair way to lose the advantages they had gained thru the conclusion of a separate peace with Ukrainia. It was, of course, impossible that events should be permitted to shape themselves in such a fashion. The Bolsheviki were constantly sending more troops from the former front to Ukrainia. It was essential to the Germans that this should be stopped, and that the Ukrainians should be strengthened. It was accordingly announced that the Russian government, by its statement of Feb 10, was considered to have denounced the armistice agreement of Dec 15, and that the armistice would therefore expire at noon on Feb 18, after a lapse of seven days from the denouncement.

Promptly at the designated time German troops began to advance into Russia. There is little doubt that the real reason for this action was the necessity for taking steps which would bring relief to Ukrainia, tho the official announcement stated that it was because the Russians refused to either accede to the German terms or continue the deliberations at Brest-Litovsk. The first troops to move were those along the Dvina and in Volhynia. Dvinsk, in the former sector, and Lutsk, in the latter, were seized without opposition. The movement was now taken up at other points along the line. A force from the vicinity of Vilna started eastward north of the Pripet Marshes, directing the

EUROPEAN WAR—Continued

main advance upon Minsk. The army occupying the positions about Riga moved along the Riga-Petrograd railroad toward Pskov. Troops from Moon Island, supplemented by others landed directly from transports, began an advance along the Esthonian coast from the entrance to the Gulf of Riga.

This energetic action on the part of the Germans apparently took the Bolsheviki leaders completely by surprise. They seem to have believed that their declaration announcing the abandonment of the war would be entirely satisfactory, or at least that it would serve to prevent any further warlike activity on the part of the Germans. When it was realized that the German forces were engaged upon a general and concerted forward movement, the Petrograd government attempted to stop the advance by agreeing to accept the German terms of peace. This offer was sent by wireless. The German leaders declined to consider the proposal unless it was made in writing and properly authenticated. Upon the receipt of this information, the Bolsheviki made haste to dispatch a courier to Dvinsk with the required documents. Seeing that they were at last in a fair way to have all of their demands met without opposition, the Germans now increased the severity of their terms to include the cession of a further large section of northern Russia and the payment of an indemnity of $1,500,000,000. It was also required that a formal treaty of peace be signed before there could be any question of a cessation of active operations. As the month closed the matter had not been finally settled. It appears, however, that all the German demands will be met; this in spite of the fact that the Bolsheviki leaders are endeavoring to rouse the Russian people to resist the advance of the invaders.

In the meantime, during all this confused attempt on the part of the Russians to arrive at an early agreement, the German advance continued practically unopposed. Tho the whole front from the Gulf of Finland to Bessarabia was affected, the main movement was on the two flanks, in the directions of Petrograd and Kiev. North of the Pripet the forces from about Vilna advanced thru Minsk and seized all the territory as far as the Beresina River. Farther north, to the east of Dvinsk, the advance was less rapid and extensive, tho still quite noticeable. General von Eichorn's army, moving eastward along the Esthonian coast, occupied the Russian naval base of Reval on Feb 25. The advance in this region continued slowly until the end of the month. None of these movements met with appreciable opposition.

The column moving along the railroad from Riga met the only considerable resistance that was offered to any of the German armies. By the 25th of the month this force had advanced as far as Pskov, at the southern end of Lake Peipus. The city was entered by the German advance guard, but the Russian forces quickly drove them out. This region offers practically the only good defensive position between Riga and Petrograd, and the Russians rallied here in an attempt to protect their capital. Severe but rather confused fighting followed for several days. As the month closed the Bolsheviki troops seemed to have been definitely defeated, and Pskov was in German hands. The Petrograd government issued a number of stirring appeals to the army to fight for the salvation of the revolution and its capital, and called upon all the inhabitants of the country to resist the invaders for the same purpose.

The force which occupied Lutsk at the beginning of the new operations did not pause there but kept on to Rovno, which was entered on Feb 20. The capture of over 9000 prisoners, 1353 guns and great numbers of motor cars and railroad rolling stock, as well as quantities of supplies was reported. From Rovno this army began a rapid advance in the direction of Kiev. The Ukrainian capital had been captured by the Bolsheviki on Feb 8, after a desperate struggle. Finding themselves in serious straits, the Ukrainians called upon the Central Powers to aid them, which the latter were nothing loth to do. The Austrians had declined to join with Germany in the advance into Russia proper, but participated in the expedition to assist against the Bolsheviki in the Ukraine. At the close of the month the main Bolsheviki forces had not yet been encountered by this relief force, tho a number of skirmishes had been fought with small detachments.

Rumanian Front

Tho the Rumanians joined with the Russians in concluding an armistice on the eastern front they did not follow that action by entering the peace conference. Germany's patience has apparently become exhausted, as an ultimatum has been presented to the Rumanian government demanding that negotiations be entered into forthwith. It was doubtless felt that the situation farther north had cleared up sufficiently so that pressure could be brought to bear upon the last remaining belligerent on the front. An outline of the German terms of peace has already been given to the Rumanians. It is understood that these terms include territorial concessions to Bulgaria in the Dobrudja, and commercial preference to Germany and Austria. It is probable that Rumania will be permitted to recoup herself for the territorial losses by the acquisition of Bessarabia.

The Rumanians have been successful in the contest with the Bolsheviki for the control of Bessarabia. They now hold practically the entire province, including the capital, Kishineff.

The rapid German advance into Russia, with the accompanying increase in the severity of the peace terms offered to them, finally convinced the powers in control of Russia's destinies that they must at once make up their minds to fight or to conclude an immediate peace. A not inconsiderable part of the Bolshevik leaders declared for the former alternative, but the "peace at anv price" element was in the great majority. The terms imposed by Germany, which have been previously discussed in these reviews, were accepted. Representatives of the Russian and German governments signed the treaty em-

bodying these terms at Brest-Litovsk on Mar 3. The Bolsheviki made no attempt to secure concessions, fearing that any delay might lead to new demands.

During the last days of the German advance toward Petrograd the Bolshevik government was transferred to Moscow. Upon the signing of the peace treaty, a Soviet of Soviets, a congress of delegates from the various local councils, was called to meet in Moscow to ratify the treaty. Considerable opposition to accepting the treaty developed, but this proved to be a minority opinion, and upon the vote being taken on Mar. 16, the ratification was carried by 794 to 261 with 115 not voting.

A new government was constituted by the congress by which the power is entrusted to a central committee of 200 members, sitting in Moscow and acting thru a cabinet. Lenine remains in control as Premier. Trotsky, who was not in favor of accepting the peace terms offered by the Germans and declined to attend the ratification congress, nevertheless accepted the position of Minister of War in the new cabinet. One of his first official acts was to ask for American engineers to reorganize the railroads and for ten American army officers to assist in training the new army, which was authorized by the congress for the defense of the country.

With the conclusion of the peace treaty, the German advance in Russia proper stopped, tho operations in the Ukraine were continued. The Germans had advanced their line an average of about 200 miles, the distance covered being fairly uniform thruout. In the north, about Reval and Pskov, the advance was less than 200 miles, while in the Ukraine it was greater. Along the other portions of the front the gain was practically constant. The line now ran along the Dnieper River in general from Kiev to Orsha, north of Bogilev; thence thru a country of small lakes and streams vía Vitebsk to Pskov, at the southern end of Lake Peipus, which it followed to the northern end. From the northern extremity of Lake Peipus the line extended straight north to the coast, a distance of about 40 miles. The German advance guards were well to the east of the main position described, particularly in the north, where they penetrated to within less than 100 miles of Petrograd. The line secured by the Germans in this advance is probably the best and shortest that could be found in the interior of Russia, and one admirably adapted to hold with a relatively small force in case of need. Berlin announced that the Germans in their advance captured 6800 officers, 57,000 men, 2400 guns, 5000 machine guns, 800 locomotives, and thousands of trucks and motor vehicles.

The German expeditions operating in the Ukraine, at the invitation of the Ukrainian Rada, for the purpose of suppressing the Bolsheviki movement there, have continued to advance despite the cessation of hostilities in the north. We thus have the curious spectacle of active operations between forces in one section after peace has been agreed upon between them in another.

Kiev was entered by German and Ukrainian troops on Mar 1. The relief of Kiev was accomplished by a compact column which moved rapidly straight upon the objective. After Kiev had been occupied the expedition apparently split up into a number of columns which operated to the east and northeast clearing the country of the Bolshevik bands. A large section of Ukrainia has already been recovered. The Germans have penetrated as far as Briansk, in the province of Orel, about 200 miles southeast of Moscow and the same distance from Kiev. Another column moved east from Kiev upon Kharkof, the center of the Bolshevik agitation in the Ukraine.

An apparently independent German expedition has been following along the northern shore of the Black Sea. Odessa, the chief city of southern Russia, was occupied on Mar 12. Continuing eastward the Germans entered Nikolayev, Russia's principal grain port, where it has been estimated five million bushels of wheat are now in storage. At Nikolayev is also a large well-equipped navy yard, which the Germans at once took over. It is reported that the entire Russian Black Sea Fleet and about 100,000 tons of merchant shipping were taken with these ports. From Nikolayev the Germans moved on to Kherson, with the apparent intention of continuing their advance until the Crimea has been occupied. Russian reports at the end of March stated that Odessa had been recaptured by Bolshevik troops, but as there have been no confirmatory details, this is probably an error.

Rumania

As has been anticipated, the collapse of Russia has compelled Rumania to make peace. The experience of this country in the war has been peculiarly tragic. A victim of Russian treachery when she was induced to enter the war and was then betrayed, she has now become a victim of the Russian Revolution. Cut off from outside support and without a base of supplies, she was forced to accept any peace terms that were offered. The terms on which peace has finally been made are dishearteningly drastic. Dobrudja as far as the Danube has been ceded to Bulgaria, a trade route to the Black Sea by way of Constanza being guaranteed to Rumania. Austria has been given the western end of Rumania, including the Iron Gates of the Danube and the control of all the western passes thru the mountains. Economic measures favorable to the Central Powers have been granted. Rumania must at once demobilize eight divisions of her army, and the rest as soon as the trouble with Russia is settled. "The Rumanian Government undertakes to support with all its strength the transport of troops of the Central Powers thru Moldavia and Bessarabia to Odessa."

Tho the last mentioned requirement is not especially onerous in its physical accomplishment, the idea that the afflicted country should have to become in effect an ally of its former enemies in the accomplishment of their designs proved to be one of the least acceptable of all the conditions. With Dobrudja a part of Bulgaria, and the Germans in con-

EUROPEAN WAR—Continued

trol of the Odessa region, the Central Powers hold practically all of the coast line of the Black Sea and all of its shipping. This may well prove of great importance, should the war continue far into the future. The control of the Black Sea is, indeed, even now a great advantage to the Turks in their operations in Armenia.

The German forces operating in Ukrainia have gained complete control of the country and are now advancing into the Crimea. They have also crossed the boundary into Russia proper at several different points, supposedly in their search for foodstuffs. Wherever opposed they have taken vengeance upon the population without mercy. In a number of instances all the inhabitants of a village have been slaughtered without regard to age or sex. It would appear that the food supplies in the Ukraine are far from as plentiful as had been supposed. In their disappointment the Germans are making the country suffer. Both the Russians and Ukrainian governments have protested against the arbitrary acts of the occupying force, but without apparent results. From present indications it can be but a matter of a very short time until the Germans entirely depose the government of Ukrainia and take over the administration of the country as a conquered province.

In Finland, too, the Germans are coming more and more to the fore. The Finnish White Guards and the German forces that came to their assistance have steadily pushed back the Red Guards who were opposing. They have now practically cleared Finland. As the campaign has progressed, the Germans have gradually been asserting their authority, until now they seem to be dictating the entire Finnish policy. The operations in Finland have been exceedingly bloody. Every victory against the Bolsheviki is followed by a massacre in which the White Guards execute most of he prisoners they have taken. As a result their opponents fight to the last rather than surrender.

The Finns have sent an expedition northward with a view of seizing the new Russian harbor of Murmansk on the Arctic Ocean. The railroad leading southward from this port is being defended by American engineers and French and British marines in co-operation with the Bolsheviki. The Bolshevik leaders have also ordered troops to the Finnish border to resist any attempt at an advance toward Petrograd. The German government has lodged a strong protest against the presence of British and Litovsk peace terms.

The looked for overthrow of the Ukrainian government has finally come. The high-handed acts of the German force in the Ukraine have been energetically opposed by the peasant population from the first, but the Rada contented itself with formal and rather half-hearted protests. The Germans soon saw that the peasants were not planting wheat for the coming harvest and General von Eichorn issued a decree requiring that the spring sowing be undertaken at once. He also ordered the suppression of all public meetings and newspapers. This action was strongly resented, and the Rada protested energetically to Berlin. Thereupon the building in which they held their meetings was surrounded by German soldiers, the Rada was dissolved and many of the leaders and ministers were placed in arrest.

The day after these events occurred General Pavlo Skoropauski, a Russian Octobrist, issued a manifesto declaring himself Hetman of Ukraine and arrogating to himself all powers of government. His first proclamation was strongly pro-German as was to be expected, and his cabinet contained no Ukrainians, consisting entirely of Russians. The great mass of the population was decidedly cool to the new government with some show of hostility, altho the Rada had not been very generally supported. The opposition rapidly grew stronger and before the end of the month it was constantly necessary to call upon the German troops for assistance in maintaining order.

In the meantime the German military operations had been proceeding steadily, if not as extensively as in preceding months. Sevastopol was captured on May 2, and the Crimea was soon entirely in German hands. Another force, moving eastward along the coast, captured Rostov at the mouth of the Don River. They were driven out again the next day by the Soviet forces. Intermittent fighting took place in this region during the rest of the month, but there was no apparent material change in the situation.

Peace negoiations between the Russian and Ukrainian governments began in Kiev on May 23, after a temporary truce had been declared on the Kursk and Voronzeh fronts. It was announced on May 25, however, that the Germans, who are ostensibly assisting the Ukrainians to preserve order, had already broken the truce by advancing in the province of Voronzeh, occupying the town of Valuiki and pushing beyond it.

In Finland the White Guard and their German allies have completely cleared the country of the Bolsheviki troops who were opposing them. It was feared for a time that the victors would not stop at the boundary between Finland and Russia, but would push on to attack Petrograd. It now seems that there was no ground for such a belief, as the Finns have ceased their advance to the east and have expressed their willingness to enter into peace negotiations with the Bolsheviki.

A new element has been interjected into the situation in Russia. Acccording to the Brest-Litovsk peace treaty all prisoners of war held by Russia and the Central Powers were to be returned to their homes. Many of the Russian prisoners have been induced to remain in Germany to till the soil or work on munitions, however. Conversely a considerable proportion of the prisoners in Russia have no desire to return to active service in the armies of the Central Powers. Many of them have settled down to remain in Russia permanently, while an appreciable number have joined the forces of the Bolsheviki, who were glad to arm them and utilize their services in this way. A great many Czechoslovaks had surrendered voluntarily, or even deserted to the Russians, later being formed into units which fought

against the Austrians. This element is now anxious to join the armies of the Allies and continue the struggle in an effort to break the power of Austria and secure the independence of Bohemia.

The organized units did not disband with the rest of the Russian army, but started eastward with the idea of crossing Siberia and then being transported by water to the western front. Recruits flocked to their colors and they soon became a very formidable force. It has been estimated that there are now from 80,000 to 100,000 Czechoslovak soldiers in the movement, with the probability that the number will be further increased.

Germany protested that the departure of an armed force from Russia with the avowed purpose of fighting the Central Powers was a violation of neutrality. Accordingly the Bolshevik Minister of War ordered the disarmament of the Czechoslovaks and promised that they would be permitted to leave by way of Archangel. They refused to disarm, however, and kept up their march along the line of the Siberian railroad. There was considerable fighting after this between the Czechoslovaks and the Bolsheviki, resulting almost invariably in the success of the former. At last accounts the Bolsheviki had entirely lost control of the Siberian railroad from Penza, west of the Volga, to the important junction point of Chelyabinsk, the first station east of the Ural Mountains. The former Austrian soldiers also hold many parts of the Siberian railroad farther east, including the important cities of Irkutsk and Vladivostok, the terminal on the Sea of Japan. The latter city was reported taken by 14,000 men, the number being constantly increased by new forces coming in from the west. The whole body of Czechoslovaks is steadily working eastward along the railroad. At the present time they have almost absolute control of the supply of food for the greater part of Russia, since their hold on the Siberian railroad and on the river traffic of the Volga (the latter due to their occupation of the city of Syzran), places in their hands the two principal lines of supply.

General Krasnov, formerly a member of Kerensky's staff, has now become the head of the anti-Bolsheviki movement of the Don Cossacks. He has been giving the Soviet leaders a great deal of trouble, tho the last reports stated that he had been severely defeated and forced to retreat. For a time he was assisted by German forces, but this support was withdrawn as a result of the diplomatic representations of the Bolsheviki. Farther south, however, the Germans operating in the Ukraine have continued their actions against the Bolshevik troops, and have occupied new sections of Russia. In a bloody battle to the west of Taganrog, on the north shore of the Sea of Azof, a force of 10,000 Bolsheviki was almost wiped out. Over 3000 bodies were counted, not including the hundreds who were drowned. The German losses were stated to have been very slight.

Despite the fighting, the peace negotiations between the Bolsheviki and the Ukrainians have kept up. The points that are reported to have been settled thus far are the delimitation of the boundary with an agreement on the methods to be followed in case of future dispute, the question of the return of nationals of the respective parties and the transfer to Ukrainia of the rolling stock that was removed therefrom.

The independence of Finland has now been recognized by Russia and by foreign governments. The independence is only nominal, however, since the country is dominated by the Germans who were called in to assist in the overthrow of the Red Guard. The Germans have taken over the arsenals, military schools, shipping and fortresses, as well as the control of all imports. They are also now in formal control of the Finnish army—the White Guard—tho this state of affairs has existed actually for some time. General Mannerheim, the organizer and former commander of the White Guard, protested against the German usurpation of power, whereupon he was retired and the German General von der Goltz put in his place. The Finnish Diet has declared for a monarchy, the former republican and Socialist majority having been reduced by executions, imprisonment and exile. It is stated that the Finns are practically unanimous in wanting General Mannerheim for king if they are to have a monarchy. It is the general belief, however, that the throne will be offered to Prince Oscar, fifth son of Kaiser Wilhelm. In the meantime Judge Svinhufvud, formerly president of the Diet and later exiled to Siberia for insisting upon the maintenance of the liberties of Finland, has been made dictator.

Ever since the overthrow of the Czar and the declaration of the independence of Finland, the Finns have been insisting upon an extension of the present boundaries, especially to the north in order that they may have access to the sea. The present government of Russia has agreed to cede to Finland a strip of territory extending to the Murmansk coast on the Arctic Ocean. The inhabitants of this region have declared against the cession and have called upon the Allies to assist them. It is not improbable that their call will be heeded. If Germany gets control of this coast, the Allies will have no access to Russia nearer than Vladivostok. It will also furnish a new submarine base.

The Czechoslovak operations in Siberia and eastern Russia have continued to grow in extent and importance. Their forces are now reported to control all of western Siberia, some 3000 miles of the Siberian railroad, and several important points farther east along the road to Vladivostok. In Russia they have extended their control on the lower Volga River, making extensive gains on both sides of that stream. They are no longer entirely dependent upon men of their own blood for recruiting their forces, as many Russians are enlisting under their standard in the hope that here may be found the salvation of their country. As a result their strength is constantly increasing. The attempts of the Bolsheviki to check the movement have been without avail. In only a few small and unimportant engagements have the Bolsheviki troops been able to stand against the Czechoslovaks.

It has been reported that German and Austrian prisoners in various parts of Siberia have organized and secured arms from the Bolsheviki for the purpose of resisting the Czechoslovaks. Little authentic informa-

EUROPEAN WAR—Continued

tion has been received, however, as to extent and success of this movement. In the meantime the opposition to the Bolshevik rule which has been manifest amongst a large part of the population of Siberia, seems about to become centralized in such a way as to make itself effective. The Provisional Government at Omsk has assumed supreme authority in Siberia. The independence of Siberia has been announced, the re-establishment of the Siberian Duma decreed, and all Bolshevik regulations annulled. The local governments thruout Siberia have been requested to approve these actions, and to elect representatives to the Duma. The new government has announced its adherence to the cause of the Allies.

The Bolsheviki have not been without their troubles nearer home. There have been sporadic uprisings at different points in Russia proper. One of the most serious of these occurred at Moscow, the very seat of government, early in the month. A violent attempt to overthrow the Bolshevik leaders resulted in several days of the most desperate street fighting. The uprising was finally put down, but reports state that it was an open question for some days as to which side would triumph. The rebellion was ushered in by the assassination of the German Ambassador, General Count von Mirbach.

To add to her other troubles, the food situation in Russia is rapidly becoming acute. Many sections of the country, and especially the large cities, are but a step removed from famine. In the wake of the food shortage, disease has spread enormously. An epidemic of cholera is raging, and is reported to be claiming hundreds of new victims in Petrograd daily. No relief is yet in sight. Despite the acuteness of the situation and the desperate need for assistance, Lenine and his followers refuse to consider receiving help from the Allies at the price of admitting troops to Russia.

At the risk of further alienating the *de facto* government of Russia, however, the Allies are taking such steps as they deem necessary to prevent the Finns and their German supporters from securing possession of the Murman coast and hinterland, which was recently ceded to them by Russia. French and British marines were landed at Kola, the ice-free port on this coast, during April. These forces have remained there since that time to protect the vast quantities of supplies sent by the Allies to Kola, the terminus of the hastily constructed railroad from Petrograd, before the Russian defection. It was announced on July 1 that American marines and sailors had been landed to support the Allied forces. German reports also affirm the the presence of Italian and Serbian troops. The entire force is under the command of Rear Admiral Kemp of the British navy. About the middle of July a part of the expedition moved south along the railroad to a point below Kem, at the southern end of the White Sea. Kem has been fortified. It was reported early in July that a force of about 50,000 Finns and Germans had started an advance against the Murman coast but nothing further has been heard of the operation.

The Germans in the Ukraine are meeting with more and more opposition as time goes on. Heretofore the resentment of the inhabitants of the country has been shown by assassination of individual German soldiers and the destruction of crops and stock to prevent their falling into the hands of the Germans, with occasional minor uprisings. During July a more determined and better organized rebellion was started. Very little news concerning this movement has leaked out, but it has been stated that an armed force of upward of 75,000 peasants is in the field against their oppressors. On July 30 Field Marshal von Eichorn, the German commander in the Ukraine, was killed by a bomb.

When Russia withdrew from the war and the eastern front vanished, the Central Powers were enabled to concentrate their efforts on the west in one grand attempt to end the struggle before the United States could enter it in force. Altho the defection of Russia was recognized as a serious blow, the Allied leaders confidently expressed their ability to win the war in the west, without the support of their former adherents. And now, at the very time that these claims are being justified by the success of Foch's counter offensive, it is beginning to appear that a reconstitution of the eastern front is not beyond the realms of possibility. Recent events in the west have sounded the death-knell of the German hopes for a favorable military decision. Should they, however, at this critical moment, be forced to send any considerable number of men to resume the fight in the east, their overthrow must be the more easily and expeditiously accomplished.

Russia has proved a snare to Germany, and the German people are becoming greatly exercised over the unsatisfactory state of affairs which has followed in the wake of the loudly acclaimed peace of Brest-Litovsk. The assassinations and uprisings which have become the rule in the sections under German military control call for a constant increase in the strength of the army of occupation—troops which can be ill spared for the purpose. Outside of the area of direct German control, the tenure of the Bolsheviki is becoming constantly less secure. It is growing daily more evident that the Bolshevik rule is approaching the end of its tether. Were proof of this fact necessary, it is to be found in the recent flight of Lenine and Trotzky to the protection of the fortress of Kronstadt, following their declaration of a modified state of war against the Allies. Everywhere the anti-German elements seem to be gaining the ascendency.

The immediate basis for the hope of the re-establishment of a real fighting front in the east is found in the success which has been attending the efforts of the Czecho-Slovaks in eastern Russia and Siberia. The Allies have finally come to an agreement as to the policy that shall be followed in Russia and have begun active steps to put that policy into effect. The first endeavor will be to assist the Czecho-Slovaks to extricate themselves from their present predicament, whereby their forces in eastern and western Siberia are separated by strong detachments of armed German and Austrian ex-prisoners assisted by Bolshevik Red Guards.

The United States and Japan will each send a force

of about 7000 men to Vladivostok to safeguard the country to the rear of the Czecho-Slovaks as they move westward thru Siberia. General William S. Graves will command the American contingent, while the entire Allied force will be under the Japanese General Kikuzo Otani. Small bodies of French and British troops will be attached to the expedition to give those countries a representation. Parts of the Allied expedition have already been landed and have joined the Czecho-Slovaks in contact with Bolshevik troops. The latter met with some slight successes in the region of the Usuri River, north of Vladivostok, about the middle of August, but toward the end of the month the Allies began an advance which soon drove the Bolsheviki back.

The Czecho-Slovak forces in western Siberia and in Russia remained practically stationary during August. Since they control the main supply routes of Russia, they are amply provided with food, but their stock of arms and munitions is decidedly meager. There is little doubt, however, that connection will shortly be established between this force and Vladivostok, when the Allies will quickly make up the present deficiency. As soon as this takes place active operations can once more be taken up. The Czecho-Slovak forces are being continually augmented thru the adhesion of anti-German and anti-Bolsheviki elements of the Russian population, mostly former members of the old Russian army. Particularly valuable are many officers of the old army, including several of Russia's ablest generals, a class especially needed by the Czecho-Slovaks .

South of the section of Russia controlled by the Czecho-Slovak Army and continuing the prospective new front are the anti-Bolshevik Don Cossacks. After months of varying fortunes, the Cossacks have finally cleared the left bank of the Don River of their enemies, and are now in control of the territory between the Volga and the Sea of Azof.

Probably the most startling and dramatic event in the history of the re-establishment of the eastern front was the sudden appearance of British troops at Baku, on the Caspian Sea, announced on Aug 15. The composition and strength of this force have not been given out, but it is stated to have been sent from General Marshall's Mesopotamian expedition. Upon its arrival at Baku, the British force joined with the Armenians and Bolsheviki in the defense of the city, an important strategic point on the road to the East and the center of the Caspian oil region. We thus see the curious anomaly of British troops fighting against the Turks here on the side of the Bolsheviki, whom they are opposing elsewhere. Another body of British troops appeared in this section at the same time—a force from India which arrived in Turkestan and joined forces with the various elements hostile to Germany in that country just east of the Caspian Sea. These British forces in themselves are not sufficiently strong materially to affect the situation one way or the other, but they furnish nuclei around which the opposition to the Central Powers may be formed, and may thus exert an influence vastly greater than their numbers would indicate.

Turning now to the other flank of the prospective front, the Allies have also greatly strengthened their position in northern Russia. On Aug 2 there occured a successful revolution against the Bolsheviki in Archangel. British, French and American troops were at once landed there and assisted in driving the Bolsheviki from the surrounding country. The Allied forces began working southward along the railroad to Vologda. At the close of the month they had covered about half of the distance to that city from Archangel. They also extended westward to gain contact with the British force occupying the country to the south of Kem, while a small British column made its way up the Dvina River in the direction of Kotlas. The Allied troops have been welcomed everywhere as they pushed the Bolsheviki before them. Manifestos have been given out that the Allies have no desire to retain Russian territory, but are intervening in order that the Russian people may be free to follow their political desires without coercion. These statements have apparently been accepted at face value by the inhabitants of the country. A "Government of Northern Russia" has been formed in the section under Allied protection, the cabinet being made up of members of the National Constituent Assembly which was dissolved by the Bolsheviki. Its political program calls for the recreation of the Russian democratic power, the re-establishment of local government on a basis of universal suffrage, the renewal of the war on the eastern front thru a reconstruction of the Russian national army, and the expulsion from Russian soil of all enemies of the country with the aid of, and in co-operation with, the Entente Powers.

There has been comparatively little news of military operations in Russia and Siberia during the past month. The few reports that have been given out are wholly favorable to the Allies. North of Vladivostok the Allies have driven their opponents from the valley of the Ussuri River and have occupied Khabarovsk at the junction of that stream with the Amur. Farther west along the Amur, Japanese and American troops took Blagovestchensk, the capital of the province of Amur and its most important town. The town of Chita and the nearby fortified heights in Transbaikalia have been captured. This success opened up communication with the forces in western Suberia via the Siberian railroad and the branch which turns southeastward from that road at Onon and traverses Manchuria. The Bolsheviki and the armed Austro-German former prisoners assisting them still control the Amur branch of the railroad and the country to its north, however. It is this branch, which has its terminus at Vladivostok, that the Allies are particularly desirous of freeing.

There has been little change in the situation in western Siberia and eastern Russia, where the Czecho-Slovaks are holding out until they can be assisted by the Allies from the east. Considerable accretions to their forces are still being reported, but they are not yet adequately armed and supplied. They have attempted no military operations during the month. To the northwest of the territory occupied by the Czecho-Slovaks,

EUROPEAN WAR—Continued

however, the peasants who are in revolt against the Bolshevik authorities have extended their control over a considerable area. It is reported that they have occupied the city of Nezhni-Novgorod, on the Volga east of Moscow.

During the last half of September the Allied forces in northern Russia resumed their progress southward from Archangel. The column working along the Dvina River toward Kotlas had advanced about seventy-five miles by the end of the month, being at that time slightly over one hundred miles from Kotlas. The troops operating up the Vaga River, which enters the Dvina from the south about midway between Archangel and Kotlas, were a little farther to the south. The important center of Shenkursk, on the Vaga, has been occupied and is now used as an advanced base, while the advanced troops are thirty-five miles beyond Shenkursk. This point, the farthest south reached by the Allies in Russia, is held by Americans. It is only forty miles from the Bolshevik base at Velsk (Bielsk). On the Archangel-Vologda railroad the Allies are about opposite Shenkursk.

But little occurred in Russia during the month. Early in October, American troops co-operated with the British in an advance up the Dvina River. Several towns were taken. Maj.-Gen. Graves' force in Siberia was reported camped on the Ussuri River, 600 miles from Vladivostok. Under date of Oct 15, the Associated Press reported the Allied column in action against the Bolsheviki on the lower Dvina. Toward the end of the month, reports of a slight retirement of the Allied forces operating south of Archangel indicated that winter had shut down sufficiently to prevent further operations.

Conditions in Russia continue chaotic. Press reports indicate that Nov 10 has been set as the date for a general massacre of the bourgeoisie and the intellectual classes, and that panic reigns in Petrograd.

SOUTHERN THEATER

The fighting in Italy has been confined almost entirely to the northern front. Here there has been a practically continuous struggle thruout the month. After resting for a few days from their strenuous efforts of the preceding weeks, the Austro-Germans on the Asiago Plateau resumed, on Dec 4, their attempts to break thru to the low lands. The operations were preceded and supported by a heavy fire from a formidable massing of artillery. They were directed principally against the positions between the Asiago Plateau and the Brenta River. The Italian lines in this section rested on a group of heights forming a considerable salient to the north.

The position was attacked from the north and west simultaneously. Due to the depth and shape of the salient it was especially susceptible to attack from two directions. Field Marshal von Hoetzendorf, who commands the attacking troops, was not slow to take advantage of his opportunity. The heights were cut off and reduced in succession from north to south. The Italian renforcements who attempted to go to the assistance of the defenders of the salient were caught in the flanking fire across its base and finally had to give up the attempt. By the 7th the attack had secured all the disputed territory as far south as the gorge of the Frenzela, behind which the Italians had organized their next defensive line. Here the advance was checked.

The Italian losses in this operation were very heavy, a relatively small part of the garrison of the salient getting out of their difficult situation. They made a valiant defense and suffered thousands of casualties in killed and wounded. The postion was hopeless, however, and many were forced to surrender. The Germans claimed the capture of over 15,000 men.

Halting the offensive west of the Brenta River, von Hoetzendorf now transferred his attacks farther east between the Brenta and the Piave. The advance in this sector was started on Dec 11 and continued uninterruptedly until the 15th. The purpose of these assaults was evidently to gain the valleys of the Calcino and San Lorenzo, down which are good approaches to the plain. The heads of the valleys were reached but further advance was rendered impossible by the Italian hold on the heights at their sides. After a short pause the advance was resumed on Dec 19, when they succeeded in storming Mt. Asolone overlooking the San Lorenzo valley, with the capture of 2000 Italians. The latter counterattacked repeatedly during the next three days and recovered a portion of the lost ground.

The invaders now once more turned their attention to the Asiago Plateau. On the 22nd and 23rd a drive along the eastern edge of the plateau gained the Col del Rosso and Mt. Valbella. The capture of 9000 prisoners was reported by Berlin. An Italian counterattack on the 25th temporarily recovered the lost positions, but they could not be retained. By nightfall they were once more occupied by Austrian troops.

This marked the end of the operations during December. Except for gun fire the front remained quiet for the rest of the month. British and French troops now hold the junction of the northern line with the Piave, the former next the river. They are not in the line which has been followed by the advance of the invading army and have not been heavily attacked as yet. A small force of French troops assumed the offensive themselves to the north of Mt. Tomba and captured 1400 prisoners, more than the strength of the attackers.

Heavy snowfall was reported along the Tyrolean frontier on Dec 31. This will doubtless mean that further attempts to break thru to the low lands can hardly hope to meet with success this winter. The supply problem of the invaders has not been of the easiest even under the favorable conditions they have had. It will now tax them to the utmost to keep the troops supplied with necessities, much less with what will be required for a continuation of their offensive.

There has been little activity on the Piave line. The Austrians have made several attempts to secure lodgement on the west bank but with no success. A

force which established itself across the river at the mouth of the old Piave, on Dec 18, was driven back on the 24th. On the night of the 31st the Austrian troops which had been maintaining a bridgehead at Zenson on the western bank of the Piave since Nov 13 were finally compelled to abandon their position and fall back behind the river.

After the Austro-German invasion of Venetia was well under way it was feared, and in fact rather expected, that the Italians would be compelled to fall back behind the Adige before they could bring the movement to a stop. This would have involved the surrender of practically all of the productive Venetian Plain, with its many important cities including Venice. The driving power of the invasion was not as great as had been anticipated, however, and it was brought to a stop at the Piave.

Then began the Austrian attempt to break thru the mountain barrier in the region of the upper Brenta and the Asiago Plateau, in an effort to turn the line of the Piave. It was rather late in the year before this movement was started, and the invaders made herculean efforts to push thru to the plains before the snow came. They were aided in their endeavors by the unusual lateness of the first heavy snows, which did not begin until the very end of December. Very appreciable gains were made, but in spite of this the main object was not achieved, and it must be accounted a decided victory for the Italians that the coming of the snows found the lines still in the mountains.

With the first snowfall, on Dec 31, the Austrian offensive was brought to an abrupt termination. Their lines of supply are of such a nature that, in this region of steep slopes and high winds, where much of the snow naturally soon finds its way to the lower ground, the provisioning and munitioning of their forces presents a most difficult problem. Only two railroads lead into the area of operations, and of these two the one running thru the Val Sugana from Trent must alone serve much of the front. For the distribution of supplies from the railroad they are dependent upon the roads of the country, which all run thru the valleys, where only the most indefatigable labor will keep them open.

The Italians, on the other hand, are relatively little troubled by the snow. It is, of course, quite deep on the actual fighting front, but the Italian communications present few difficulties. The milder temperature and readily traversable condition of the lowland but a few miles in their immediate rear give a peculiar advantage at this time of year to troops facing north, as compared to their adversaries fronting in the other direction. Under such conditions a reversal of the rôles of the opposing armies was to be anticipated. No more favorable opportunity could be expected by the Italians for regaining a tenable line, well into the mountains, which could be fortified and made thoroly defensible before the return of warm weather permits a renewal of the Austrian offensive. The former defenders were not slow to take advantage of the sudden reprieve granted them by the weather. January witnessed several blows delivered by them in an effort to offset the gains formerly made by the invaders. Tho no very extensive gains were recorded, the advances made are important on account of the favorable influence the new positions will exert on the contiguous sections of the front. The movement will doubtless be continued while the rigors of the mountain winter reduce the effectiveness of the enemy. Weather conditions should continue definitely to favor the Italians until about the middle of March, so they still have a considerable period in which to accomplish their aims.

For the first two weeks of January there was little activity on this front except for artillery exchanges and trench raids. The French followed up their local success of Dec 30 north of Mt. Tomba by a series of raids and minor actions, which advanced their lines somewhat. The British on the right of the French troops also carried out a number of trench raids during the first week of January. In one of these, several small detachments crossed the Piave and raided the Austrian trenches on the east bank of the river.

On the afternoon of Jan 14 the Italians attacked in the Monte Asolone region from north of Osteria il Lepre to the head of the Cesilla Valley. The attack was effectively supported by artillery and gained considerable advantages, at the same time inflicting heavy casualties upon the defenders. Thirteen officers and 478 men were taken prisoners. As a diversion storming parties penetrated the Austrian trenches in the Monte Solarlo salient, but made no attempt to extend their successes. The Austrians in the Asolone region counterattacked almost immediately but were repulsed. The next day they once more attempted to regain their lost positions, accounts differing as to the result of their attack. Vienna states that most of the lost ground was retaken, while the Italians claim that they rectified their new alignment during the night of the 14th and repulsed all the Austrian attacks the next day.

On Jan 23 it was announced that the Austrians had abandoned Monte Tomba and had fallen back as far as Monte Spinoncia. Italian reconnaissance parties noticed that the Austrian patrols and sentinels had been withdrawn, and soon discovered that the entire position had been evacuated. This withdrawal may be attributed to two causes, the recent French gains north of Monte Tomba, which made the position insecure, and the heavy snowfalls, which have rendered difficult the supply of those troops distant from the railroad. While the front affected is only about four miles in extent, the Italians are benefited in that the lines are at a greater depth into the mountains, giving that much more territory that must be penetrated by any future offensive toward the plains. The retirement is of further importance as an indication that the Austrians have abandoned all present intentions to force a passage

EUROPEAN WAR—Continued

to the Venetian Plain by the west bank of the Piave.

A few days later the Italians launched a successful offensive west of the Brenta River, on the eastern edge of the Asiago Plateau. The attack was started at 3 o'clock on the morning of the 28th, the first shock being delivered against the height of Col del Rosso. Exceedingly stubborn fighting developed and it was not until the height had been taken and retaken three times that the attackers finally secured definite possession of their objective.

This capture of Col di Rosso was but the preliminary to the main movement which was directed against the dominating Monte di Val Bella. Here severe fighting took place thruout the night of the 28th. After a prolonged hand-to-hand struggle up the slopes, the Italians at last established themselves on the summit at 11 o'clock the next morning. A simultaneous attack against Mt. Sisemol was repulsed.

The Italians captured over 2600 unwounded prisoners, while the Austrian losses in killed and wounded were very heavy, being estimated at from 5000 to 6000 men. Prisoners reported that two Austrian divisions were practically destroyed, while two other brigades of Kaiserjaegers were badly cut up. The total Italian losses were considerably less than the number of prisoners taken. The Austrian counterattacks were all abortive. They experienced great difficulty in bringing up reserves, thru the interference resulting from the streams of beaten troops moving to the rear, while the Italian artillery, aided by observers on the newly won height, succeeded in bringing an effective fire on the Austrian masses, materially adding to the confusion. At dawn on Jan 31 an Italian force from Monte di Val Bella reached by a sudden thrust the head of the Melago Valley. This gain also was held against the counterattacks made on it.

By their latest successes the Italians have set at naught the results of the Austrian gains in their offensive just before Christmas, at which time they seriously threatened to push down the gorge of the Frenzela to the Brenta, and so on to Bassano. The two heights just retaken are the key positions of the wrole Frenzela section and block that path effectually. In addition to their local effect these eminences also dominate the Asiago Plateau to the west and the valley of the Brenta to the east. Their possession will therefore be a great advantage in any further Italian attempts to utilize the opportunities which the weather conditions now offer.

The Piave line presents little of interest. Except in the delta region only artillery actions have been reported. The Austrians have abandoned their attempts to seize and hold bridgeheads on the western bank of the river, the occasion for their use being apparently far distant. There seems little prospect of the Piave being forced by a direct operation. The chief end, then, of the establishment of bridgeheads on the Italian side of the stream would be for the purpose of taking advantage of a retirement brought about thru the flanking of the line by the troops operating in the mountains. With the movement in the north brought to a stop, the maintenance of bridgeheads farther south would have cost more than they were worth.

The exception to the statement that there was no activity on the Piave was in the vicinity of the bridgehead which the Italians recently wrested from their adversaries near the mouth of the river. Numerous local actions were fought here during the latter half of the month due to the Italian efforts to extend their holdings, and the resulting Austrian counterattacks. The most extensive of these minor affairs was the Austrian attempt to regain the whole position on the night of Jan 17. They attacked on a wide front, but the movement was discovered and the Italian guns broke up the attack, only a small part of the assaulting forces reaching the wire which they were unable to penetrate. The net result of the more or less confused fighting in this region was that the Italians slightly enlarged their position and held the ground they had gained in the face of their opponents' counterattacks.

It appears from the latest accounts that the Italians, with the aid of France and Great Britain, have established a definite ascendancy over their enemies in both artillery and aircraft. Particularly in the air do they seem to be supreme. The Austrians occasionally succeed in getting a bombing squadron thru the lines for operations in the rear, but the air in the actual theater of operations evidently is under the control of the Allies.

General von Hoetzendorf has been succeeded in command of the Austro-German army of invasion by General Boroevich. The latter's military tactics have been uniformly defensive in the past. His appointment is construed as a concession to the Slav element in Austria, since General Boroevich is of Croatian-Slav origin.

The Italian front was devoid of any extensive operations during February. In the early days of the month the Austrians made a number of attempts to regain the ground which they had lost to the Italians late in January. After several days of artillery duels and encounters between patrols, the Austrians attacked heavily on Feb 10 along both sides of the Frenzela, and on the slopes of Sasso Rosso, farther east. The assaults were stopped by artillery fire alone, none of the attackers penetrating to the Italian trenches. Further attempts were made the next day with no better success, tho Rome reported that very considerable forces were employed. On Feb 12 the Austrians essayed an advance at Col Capuli on the Brenta. Here, too, they were repulsed.

The total failure of the Austrians to attain even partial successes in these assaults seems to be due to the superiority of the Italian artillery, aided by that of the French and British. In addition to having a greater number of guns, the Allied gunners are in possession of the better positions. Aided by the

observation stations on the newly won heights, they have been enabled to deliver a concentrated cross-fire upon the relatively few and constricted avenues of advance open to the Austrians. The Allies made the most of their advantageous positions, every attempt of the enemy to advance being broken up in the early stages. The Austrian reserves also suffered heavy casualties as they were under direct observation of the stations on the mountain tops.

After the middle of the month affairs assumed the aspect that is ordinarily described by the term "a quiet sector of the front." There were artillery exchanges, but no attacks by either side. Italian patrols were busy, but the Austrians appear to have refrained from even this sign of activity. With the definite failure of the Austrian efforts to retrieve their losses, they assumed an attitude of complete passivity. The Italians, on their part, made no attempt to continue their successes of January in pushing the invaders farther back into the mountains. They are, however, in much better shape than they were at the close of the invaders' advance in December. This statement is based largely on the fact that the elapsed time has given them an opportunity to greatly strengthen and consolidate their positions. The few advances they have made, since the coming of the winter snows stopped the invasion, moreover, have been at points which are exceptionally important as being the keys to the only practicable routes thru the mountains.

During the last days of the month the reports chronicled a pronounced increase in the artillery activity on the section of the northern front between the Asiago Plateau and Lake Garda. It has been reported from Rome that aerial reconnaissances have disclosed activities behind the Austrian lines in this region which appear to indicate preparations for important operations here. It will be remembered that this was the scene of the unsuccessful Austrian attempt to break thru the Italian lines last spring.

The Italian class of 1900 is reported to have been called to the colors in preparation for the anticipated greater activity in the spring. With the greater power recently given the Allied War Council to shift troops as the necessities of the moment may require, thus making possible an early reinforcement from other fronts of any threatened sector, the situation in Italy is now vastly improved over what it was last fall. The front is much stronger, the Italian troops themselves are in better condition, and it will require much less time under present conditions to reinforce them in case of necessity. All in all the Austrians should find, in case they attempt to resume their interrupted invasion upon the return of favorable weather, that the difficulty of their task has been enormously increased.

There was practically nothing resembling active operations on the Piave line during the month. Artillery firing became rather brisk at times, but the infantry did not become engaged except for one or two local Austrian attempts to reach the western bank of the river by surprise. These failed of success. Aerial activity continued unabated, the Allied airmen retaining the supremacy.

The Italian front has remained without activity of any importance thruout the month. There has been continuous artillery fire by both sides, rather desultory most of the time but occasionally attaining the intensity of a real artillery battle. The infantry contented itself with minor reconnoitering actions, few of which were more than patrol encounters so that they could hardly be classed even as raids.

It was reported from Rome in the first part of the month that activity in rear of the Austrian line in the mountains indicated the possibility of an intention on the part of the enemy to begin more ambitious operations. Nothing came of this, however, and the front remained quiet. Toward the end of the month the Austrians took the initiative in the patrolling of the territory between the lines at the western end of the mountain front. In the other sectors the invaders appeared to be less aggressive.

The latest estimate of the strength of the forces on the Italian front places the number of Austrian divisions at 42, with only 3 German divisions remaining of those which assisted in the big drive on the Isonzo line last year. While this is a considerably less force than was engaged in the attacks before, it is amply strong to make a resumption of the offensive probable upon the return of good weather. The mountains still remain locked in snow, but this condition will doubtless change before long.

Another month has passed without any operations of note on the Italian front. Reports indicate, however, that it is becoming increasingly evident that the Austrians are making preparations for an offensive in the near future. The intended area of operations is believed to be in the mountainous region west of the Piave River, possibly extending as far west as the Swiss frontier. The Austrians have strongly entrenched themselves on the line of the Piave and have also fortified the Livenza and Tagliamento in rear. It is thought that they will adopt a defensive policy on the east while concentrating their energies on the northern front. Large numbers of Austrian troops who were formerly on the Russian and Rumanian fronts are now said to have been added to those facing the Italians. The snows in the mountains should begin to go during May, whereupon great activity may be expected. If the Italians are correct in their estimate of what to expect, it is not improbable that the next month may witness the initiation of the movement.

The Italian front is again beginning to show signs of activity, after several months of but trifling operations. The snow, which was so late in starting to fall last winter, has only recently begun to melt sufficiently to permit of a resumption of hostilities. Even yet it is reported that the snow on the Austrian side of the line is in many places of considerable depth. Possibly this is the reason that the initiative in the minor operations, which are all that have characterized the front thus far, has been taken by the Italians, tho the highlands in rear of the Austrians are beginning to be fairly passable, according to the reports.

EUROPEAN WAR—Continued

The first break in the winter program of desultory artillery exchanges and reconnoitering raids came on the night of May 9, when a number of small detachments of Italian infantry stormed the strongly organized heights of Monte Corno. The attack was delivered as a surprise, and met with complete success. In addition to gaining entire control of the entrenched positions, the Italians captured about 100 prisoners, 2 guns, and several machine guns.

Monte Corno is about eight miles south of the city of Asiago, at the southern edge of the plateau of the same name. Its importance lies in the fact that it controls the passage to the south thru the Val d'Arsa. The Austrians evinced a strong disinclination to give up this advantageous point, and launched several strong counter attacks against the mountain during the ensuing week. All of these attempts were repulsed by the Italians, with heavy losses to the attackers.

This minor action on the part of the Italians seemed to have the effect of waking up the whole front. During the remainder of the month the raiding and patrolling parties thruout the mountains were more active and aggressive than for a long time previous. Toward the end of the month the Italian *Alpini* carried out one of the most brilliant minor mountain attacks since the beginning of the war. This was the capture of the basin of Presena Lake in the Tonale region, northwest of Trent, after forty hours of the fiercest fighting against a numerically superior foe, well entrenched in fortifications constructed before the war and since strengthened. After attacking four times under a heavy fire, the Italians finally overwhelmed the enemy by a bayonet charge. Among the results accomplished by this success were the blowing up of an important Austrian munition depot and the capture of two telegraph lines which ran thru Paradise Pass.

On the night of May 26 Italian troops broke into the Austrian defenses at Capo Sile, near the mouth of the Piave, to a depth of 750 yards. Much material and 433 prisoners were taken. The positions reached were maintained against the Austrian counter attacks. The report from Rome stated that the Italian losses were very slight, while those of their opponents were quite severe.

Despite the fact that the spring activity on this front has been initiated by the Italians, many writers are looking for an Austrian drive against Italy in the near future. At intervals for the last two months reports from Rome have chronicled activities behind the Austrian lines which seemed to indicate an offensive intention on the part of the Austrians. The latter appear, however, in no way anxious to resume hostilities. The political situation at home is such that they would probably be content to let well enough alone if the matter were left to them for decision. Germany, on the other hand, is naturally desirous that an offensive be launched in the Italian theater as a diversion to the German activities in France and Belgium and to prevent the shifting of troops to this latter theater. In view of the weight which attaches to the wishes of Germany in the councils of the Central Powers, it appears highly probable that the Austrians will undertake a drive into Italy in the near future.

The Italians are now in much better shape to meet an offensive than they were when the weather forced the cessation of the attacks upon them last winter. Since then the defensive lines have been greatly strengthened, while the most threatening avenues of approach to the plains which the Austrians had secured have been closed by the recapture of points dominating them.

The strength of the Austrian army on this front is not very definitely known. At last accounts it was estimated that they had about 900,000 men. It is understood that the provinces of Galicia and Bukowina have recently been returned to the civil administration from military control, and that practically all of the troops that were in those provinces have been despatched to Italy. In addition to the flag of Austria-Hungary, those of Germany, Turkey and Bulgaria are flying from the headquarters of the invading forces at Udine. It is believed that the number of troops from the other nations in the Central Alliance is, however, merely nominal, and that Austria must depend upon her own resources. Certain it is that Germany can not spare any appreciable number of troops from the western front, and the Austrians, when unsupported by their allies, have not heretofore been very successful against Italians, or indeed against any of their opponents.

During the winter thousands of men from the Jugoslav regiments of the Austrian army have deserted to the Italians. In some cases whole companies have gone over intact. These men have been organized, together with volunteers of the same races from other parts of the world, into separate units, which are to be used by the Italians against their former leaders. In view of the present unrest within the Dual Monarchy, this gives the Italians a powerful political asset, whatever may be the fighting value of the troops so formed.

It is known that Italy, largely by the utilization of her waterfalls to furnish electric power, has more than replaced the armament lost in the invasion last year. She has also increased the number of men under arms until she has recently been able to spare several divisions for service in France. Possibly more important than the other factors of increased strength is the recently adopted policy by which the authority of General Foch has been extended to include the Italian front, thus insuring a complete co-ordination of all the Allied activities in the principal theaters of war.

In the view of the Italian military experts, conditions have so changed since the suspension of activities in January that it is very doubtful if the new offensive, when it comes, will be a continuation of the former movement. Instead it is believed that the blow should be looked for to the west of Lake Garda. A successful drive here would force the evacuation of the present lines as well as one farther east, while it is much nearer France and would thus serve two ends at the same time.

The long looked for Austrian offensive against the Italians has finally been started, and its first phase, at least, is already a thing of the past. The last half of

June saw not only the initiation of the movement, but also its arrest after some initial successes, and then its total repulse, with the restoration of the lines to their original positions.

The Italians were well prepared for the attack. For months the concentration of troops and material behind the Austrian lines along the Piave and on the mountain front have given warning of an impending blow. In the latter part of May it was estimated that there were 900,000 Austrians confronting the Italian positions, and reinforcements were arriving continuously. A despatch from the Italian Army Headquarters on June 9 stated that the railroads behind the Austrian lines were being rushed to their full capacity night and day in bringing troops to the front, distributing them to the different sectors, and moving heavy guns and enormous quantities of munitions to positions near the front. By the middle of June, when the offensive was launched, it is stated that the Austrians had 7500 guns on the one hundred miles of front attacked, and approximately one million men—eighty divisions of infantry and twelve of cavalry. Less than half of this force participated in the attack since affairs developed in such a way that few of the supporting troops could be thrown in.

The strength of the defenders was considerably greater than that of the invading force. The Italian army is now supposed to amount to about three million men. Several divisions of Italians were sent to France to assist in checking the German offensive, but they are just about counterbalanced by the French and British contingents which were hurried to Italy last fall as supports to the hard pressed armies in retreat from the Isonzo. The despatch of Italian troops to France this spring appears to have been done rather in accordance with the new policy of having representatives of all the Allies in each of the different sectors than for the purpose of altering the relative strength on the two fronts. The French and British troops in Italy have been holding two of the most important sectors on the front, the former east of the Brenta River, in the Mt. Grappa region, and the latter on the heights along the Piave near the point where the defensive line leaves the river and swings westward thru the mountains.

The Austrian attack was delivered on the whole front from the Asiago Plateau to the sea, a distance of between ninety and one hundred miles. The strategy of their offensive was based entirely upon the shape of the defensive line. By attacking simultaneously on both the northern and the eastern faces of the great redan formed by the Italian positions, a success on either face would force the hasty abandonment of the other. In the event that the defensive lines on both faces were broken thru a large portion of the Italian army must necessarily fall back in a disastrous retreat with no escape from heavy losses by capture. The Italian lines of communication are such that there were good chances of the movement succeeding if the initial break in the lines could be made. It was a most ambitious plan, but failed dismally of accomplishment.

At three o'clock on the morning of June 15 the Austrian artillery opened a terrific preparatory bombardment all along the line. Not only was the front line heavily shelled, but the rear areas, too, were thoroly covered by fire. Gas shells were used extensively. The infantry advanced to the assault after four hours of this fire. Following the tactics of von Hutier the assaulting troops had been kept well to the rear until just before the attack, being then brought up to the front secretly at night. As an indication, however, of the complete knowledge that the Italians had of their enemies' plans, it is significant that the reports show the beginning of the defensive barrage and counter battery fire at twelve o'clock—three hours before the Austrians opened up.

The Austrian attack was very evidently intended to convey the impression of a general advance upon the whole line as stated above. It quickly developed, however, that the only serious attempts were the concerted, but really independent, assaults upon a series of important key positions at predetermined points. Chief among these were the Asiago Plateau and the valley of the Brenta, on the mountain front, and along the Piave the heights of Montello, the Zenson sector and the coastal region.

The offensive in the mountains achieved scarcely a semblance of success, even at the start. On the Asiago Plateau, the extreme western limit of the attack, the defenders stood absolutely fast—in fact they offered such a strong counter pressure that they even advanced their lines slightly at some points in the face of the assault. Along the Brenta and on the plateau just to the east of that stream some initial successes were attained by the attackers. Vienna reported at the end of the first day's fighting that the defensive positions had been pierced as far as the third line. A considerable portion of this ground was recovered immediately thru counter attacks by the Italians and their allies. This pressure by the defenders was continued and on the 18th it was reported that the original lines had been regained thruout most of the sector. It was said that many of the mountain passes were literally choked with Austrian dead, so severe were their losses.

On the Piave front, which very quickly became the most active and most bitterly contested, the invaders achieved rather more extensive successes at the outset. The most northerly of their important river crossings was made in the sector of Montello heights. This plateau consists of a series of hills jutting rather abruptly out of the surrounding lowland. It is separated from the mountains by a broad level plain, which it commands, thus serving as a buttress for the eastern end of the mountain line. It similarly commands the Piave line to the southeast, there being no more high ground between it and the sea.

This sector of the line was held partly by British and partly by Italian troops. At the beginning of the offensive on June 15 the Austrians, here under the command of Archduke Joseph, forced a crossing of the river and secured a foothold on Montello. The village of Nervesa, at the eastern end of the heights, was captured, being organized into a bridgehead. Fifteen ponton bridges were thrown across the river at and near Nervesa to afford easy communication between the

EUROPEAN WAR—Continued

two banks of the river. On the 16th the Austrians continued their furious assaults on the heights. They improved and extended their positions considerably, but failed to secure the crest of the ridge. The next day there was relatively little fighting here. Both sides seemed willing to make the inclement weather, a reflection of torrential downpours in the mountains, an excuse for taking a breathing spell after their strenuous exertions of the previous days.

The Piave was crossed at numerous points between Folina and the sea, but only in the neighborhood of Zenson and in the swampy region farther south did the Austrians do more than reach the right bank of the stream and establish a precarious hold on a narrow strip of land close to the river. From Zenson the invaders pushed forward to the west and southwest until they had reached a line from three to four miles from the Piave. Between the Fossetta Canal and the Sile an Austrian force advanced westward from Santa Dona di Piave, clearing the area to a line west of Fossetta. At the same time the troops south of the Sile, under the command of General von Wurm, took Capo Sile and extended their holdings in the surrounding country.

So far the Austrian operations might be considered to have met with at least partial success, despite the failure in the mountains. Crossing a river in the face of an active enemy is always a most difficult operation. The Austrians had succeeded in crossing the Piave at many points and had made good their hold on the right bank, for the time being at least. But gaining the opposite bank is not the really vital part of forcing a river line. In order that the operation may lead to any important result it is essential that the troops who have already crossed be reinforced rapidly, so that the position on the enemy bank may be extended until sufficient ground has been gained to admit of free maneuver. A mere crossing without the later extension is really a disadvantage. The attackers are in an awkward position, since they must fight with the river at their backs and without room to maneuver. A successful counterattack by the enemy must necessarily spell total disaster.

In two different regions—at Montello and south of Zenson—the Austrians had secured sufficient territory on the right bank of the Piave to give promise of greater successes to follow. In both sectors the lines had been extended until there was a considerable stretch between them and the river, giving room for the collection of supports and affording reasonable security for the bridges. The hold on the Montello Plateau was probably the more threatening to the Italians. If the invaders succceeded in extending their gains here to include the whole of the heights, the entire Italian line was compromised. But the defenders resisted stubbornly. The Austrians found it impossible to advance farther and they had not yet secured a great enough extent of territory to make their position safe.

At this critical juncture the weather, which aided the Italians so materially on the Tagliamento last fall, once more turned against the Austrians. Heavy rains in the mountains raised the Piave to the flood stage, whereas it had up to this time been unusually low. Most of the Austrian bridges were swept away. It proved impossible to lay any new ones across the raging river, and the few tenuous connections that were left between the two banks were maintained only with the greatest difficulty. Under these conditions the Austrians were unable to send across the river the men and materials that were essential to a continuation of their offensive. It was only by herculean efforts that they succeeded in supplying their advanced troops with ammunition and meagre supplies so that they might defend themselves.

The Italians were not slow to take advantage of their enemies' predicament. They attacked fiercely all along the line, the Austrians countering in an effort to render their positions safe while there was yet time. The Italian assaults increased in strength from day to day as their reserves came up. The heaviest fighting was in the Montello region. Here the Italians gradually forged ahead on the 20th, 21st and 22nd. On the night of the last mentioned day the Austrians withdrew across the river at all points as far south as the lagoon region. Accounts differ concerning the success that attended this movement. Vienna reports that the troops were withdrawn quietly by night with practically no loss, the retirement not being noticed until the bulk of the forces were across the Piave. The Italian version is that the retirement was discovered at its very inception; that the Austrians, attacked by infantry and subjected to a heavy artillery fire, suffered severe casualties, were thrown into the greatest disorder, and had to abandon most of their material. The Austrian rear guards, which did not get across the river until the next day were badly cut up and lost about 4000 prisoners.

The only fruits of their offensive which still remained in the hands of the Austrians were now the gains about Capo Sile and the slight advances they had secured in the mountains on either side of the Brenta. The Italians attacked in both of these areas on June 24. Capo Sile and some of the contiguous territory was retaken, these gains being somewhat extended on the 25th. In the mountain area the Italian attacks also made some progress, tho the Austrians still held a portion of their gains here.

The whole operation must be looked upon as a decisive defeat for the Austrians. After taking months to prepare their stroke, and with the experiences of the German offensives in the west to assist them in laying their plans, the best they could achieve was a dismal failure. To be sure they were handicapped by the weather, but it would be unjust to the Italian troops to give the weather a predominant value in the Austrian repulse. Their advance had been stopped by hard fighting before the sudden rise of the Piave came. There is no reason to suppose that events would have taken a different course, tho probably less rapidly, even had there been no flood. With the first advance checked and the Italian reserves on their way, there can be little doubt that the offensive was doomed in any event. An interesting commentary in this connection is the exceedingly slight advance made in the first

stages of the blow. It has been the unvarying experience of the war that any major offensive will make appreciable gains at first, whatever the ultimate outcome may be. In no former case have the initial gains been so meagre. Is this because the Austrian troops are below par, or are the Italians relatively so much better? Probably both factors have something to do with the result. At no time have the Austrians shown themselves to be first-class troops, and their morale is now reported to be at a particularly low ebb. The Italian army, on the other hand, has been practically remade. It is stated to be in immeasurably better condition now than at any previous time during the war. Moreover they were ready for the blow; it has even been hinted that they were about to launch an offensive of their own when the Austrian movement started.

The retreat of the invader to the east bank of the Piave on the night of June 22 does not seem to have been forced by any immediate military necessity. The Italian counter attacks had not yet made such deep inroads into the Austrian positions as to threaten their tenure for a few days at any rate. The crossings had become useless, however, and nothing was to be gained by continuing to hold them. The delay in the development of the offensive had given the defense the opportunity to bring up reserves in sufficient numbers to prevent any further extension of the foothold on the right bank. As days went by the Italian strength would be constantly augmented, whereas the destruction of the Austrian bridges prevented their own reinforcement. There was great danger that if the retreat was delayed for long the possibility of extricating the forces to the west of the river would be lost. There is little doubt that the decision of the Austrian command to withdraw while there was yet time was very wise under the circumstances.

There has been much speculation concerning the effect that the Austrian reverse would have upon the civil population of the Dual Monarchy, to say nothing of its army. The offensive was initiated with many promises of relief for conditions at home that would result from the success of the movement. Its total failure must have a most serious effect upon the morale of the whole nation, both civilians and soldiers. On the other hand, the Italians are justly elated with their success. One of the most interesting phases of the whole affair was the attitude of calm confidence shown by the entire Italian nation, not only the army at the front but thruout the country. The difference between the national state of mind now and at the time of the reverse last fall furnishes an index to what may be expected from Italy in the future. Observers have been telling us for some time that the country had at last found itself and was now whole-heartedly behind the army, which, reorganized and confident of the support of the nation, was in vastly better condition than ever before. The truth of these statements we can now see for ourselves.

At the very end of June the Italians, supported by French and British troops, took the offensive in the mountains. On the 29th they captured Monte di Valbella, after a desperate struggle. Over 800 prisoners were taken, besides some guns, trench mortars and many machine guns. The Austrians counter attacked several times during the day and the following night, but were repulsed each time. On the 30th the attack was extended to include Col di Rosso, about three-quarters of a mile southeast of Monte di Valbella, and the peak of Echele in the same area. The Italian assault was begun early in the morning. The fighting lasted all day, but by nightfall both peaks had been secured. While this action was under way the Austrians launched two heavy attacks against Monte di Valbella, both of which were beaten back with great loss to the attackers. The fighting of these two days resulted in the capture by the Italians of 85 officers and 935 men. Much material was also taken and severe losses were inflicted upon the Austrians.

After the violent struggles of the preceding month the Italian front seemed comparatively quiet during July. There was, however, a great deal of fighting, tho mostly in the form of local actions, few of which were of much effect in altering the general situation.

On the morning of July 2 the Italians once more took up their attack against the Austrians in the mountains, when they stormed a number of important positions in the Grappa region, capturing 569 prisoners. At the same time a heavy Austrian attack on the Asiago Plateau was wholly crushed. On the 3rd the Austrians counter attacked the Grappa positions which they had lost the previous day. They were entirely unsuccessful, and left 621 more prisoners in the hands of the Italians. The latter again assumed the offensive on the 4th. Northeast of Monte Grappa they penetrated the enemy positions at the head of the Calcino Valley. These gains were maintained in the face of unusually fierce counterattacks, which developed into prolonged hand-to-hand fighting.

In the meantime the Italians had transferred the principal fighting to the coastal region. On July 2 they began a series of energetic thrusts against the Austrian positions on the right bank of the Piave near its mouth. despite the flooded condition of the country and the desperate defense offered by the garrison of the Austrian trenches, the attackers gained ground steadily. By the 5th the Italians had reached the west bank of the Piave's main channel from Grisolera to the sea. The Austrians attempted to check the offensive by means of a violent counter blow to the north of Chiesanova. This was arrested, however, and on the 7th Rome announced that the right bank of the Piave had been completely cleared. By this successful attack the Austrians were driven from ground which they had occupied ever since last November, when they first crossed the Piave near its mouth and threatened Venice, only to be checked by the flooding of the country by the Italian engineers. Something over 3000 prisoners and a number of guns were taken during the operations of these five days.

In the official statement announcing the repulse of the Austrians to the left bank of the Piave, the Italian captures from the beginning of the Austrian offensive were summarized as follows: "Altogether, since the 15th of June, 523 officers and 23,911 other ranks have

EUROPEAN WAR—Continued

been made prisoner. We also captured 63 guns, 65 trench mortars, 1234 machine guns, 3700 rifles, 2 airplanes, 4,000,000 rifle cartridges, . . . and recovered our artillery and material which, in the advanced zone, had to be abandoned in the first phase of the struggle."

A despatch given out on July 20 stated that Italian troops had driven the Austrians from Monte Stabiel and had completely reoccupied Corno di Cabento. These two peaks are just north of the great Adamello glacier which blocks the western side of the Trentino between Tonale Pass and the Val Vermiglio on the north and the Val di Giudicaria on the south. They command the Val Vermiglio, along which runs a good highway toward the northeast to Bolzano.

There were no other operations of importance in this theater during July. The Italians made slight gains in the eastern mountain sector and repulsed a number of spirited Austrian attacks on the Asiago and near Monte Grappa. None of these actions materially affected the situation, however.

American fighting troops began arriving on the Italian front on the morning of July 27. Heretofore the only combatant troops from the United States in Italy have been aviators. No statement has been given out as to the projected strength of the American contingent in the Italian theater.

The German General von Below, who commanded in the Isonzo drive last fall, is reported to have been placed in command of the Austrian armies on the Italian front, succeeding Field Marshal Boroevic.

The Italian front remained quiescent during August. Nothing remotely resembling major operations was attempted by either side, while the few signs of minor activity displayed by the Allies were evidently for the purpose of keeping the enemy on the alert on all fronts to prevent the shifting of troops.

On the night of Aug 2 French detachments raided the Austrian lines at Zocchi, to the east of Asiago, and took 125 prisoners with a quantity of material. The next day Italian troops stormed Hill 173, on Dosso Alto, capturing 176 prisoners. The Austrians had held this position since their offensive of June 15.

Austrian attacks against the Col del Rosso salient on Aug 8 were everywhere repulsed. That night the British carried out eight simultaneous raids on the Austrian positions between Asiago and Canove. Heavy casualties were inflicted upon the enemy and 315 prisoners were brought back. On the morning of the 10th French troops penetrated deeply into the Austrian lines on Monte Sisemol, destroying part of the garrison and forcing the remainder to surrender. The prisoners numbered 250.

The Italians advanced in the Adamello region near the Swiss border on Aug 12 and 13, taking Monte Montello. At dawn on the 14th an Italian detachment crossed the western branch of the Piave south of Grave di Papadopoli and seized one of the large islands in the river there. Several Austrian counter attacks failed to recover the lost island.

After the middle of the month even the small enterprises of the Allies became rarer and rarer. Nothing occurred except an occasional raid launched for the purpose of obtaining information. There appear to be few indications of an early resumption of operations on a large scale. It has been reported that a new Austrian offensive is in course of preparation, but this is totally without official confirmation. On the other hand it is known that at least a few Austrian divisions have been sent to the western front and are now in reserve behind the German lines. This does not seem to indicate any intention to attack in Italy in the near future.

The Italian front has been even less active during September than it was in the preceding month. Actions of the most minor character have alone disturbed the usual quiet routine. On Sept 14 the Italians captured an enemy defensive system on the Grovella, south of Corte, with 343 prisoners. At dawn on the 16th they took about the same number of men when they stormed a strongly defended position in the gorge of the Brenta. On the 23rd, after several days during which a number of Austrian local attacks were repulsed, French troops made a slight advance on the Asiago Plateau, capturing 100 prisoners. With these few unimportant exceptions, artillery fire and infrequent raiding operations have been the only signs of hostility on the front.

There had been little military activity on the Austro-Italian front for several months, the main effort of the Allies being concentrated on the western front.

Early in October, Austria began to give evidence of increasing internal stress and her need for peace. On Oct 7, thru the Swedish minister in Washington, Austria addressed a note to President Wilson asking for an armistice based upon the terms laid down by the latter in his message to Congress of Jan 8, 1918, and his address of Feb 12, 1918. This was replied to by President Wilson on Oct 19, calling attention to paragraph 10 of the fourteen peace requirements relative to the autonomous development of the peoples of Austria-Hungary, to the changed conditions, refusing to accept mere autonomy for these peoples, and insisting on their right to full judgment as to their future destiny as members of the family of nations.

In the early part of October, only minor military operations, patrol encounters and the like, were reported. Local fighting occurred on the front between Lake Garda and the Brenta about the middle of the month, but in general nothing but minor activities occurred until the front suddenly flared up on Oct 24. An offensive at this time was well calculated to expedite the consideration and acceptance by Austria-Hungary of the terms of the armistice.

The offensive was commenced on the mountain front between the Brenta and Piave Rivers on Oct 24, and was participated in by British, French, and Italian troops. The British gained a footing on some islands in the Piave, the French took Monte Sisemol on the Asiago Plateau, and the Italians crossed the Ornic River in the Monte Grappa sector and captured Monte Solarole, part of Monte Prassolan, and Monte Pertica.

These operations resulted in the capture of about 3000 prisoners. Heavy fighting occurred in the Monte Grappa region the following day, marked by the capture of 2000 additional prisoners. Now came the main offensive which resulted in forcing the crossing of the Piave by the British and Italians. Conegliano, five miles northeast of the Piave, was captured on Oct 28. The official reports state that the British 10th Army was engaged in these operations. Other reports indicated only one corps in action. Detailed reports of the operation show the progress of the attack to have been rapid against a weakening defense.

By Oct 29, Vittorio, terminus of the Treviso-Udine railway, was reached. The offensive front spread from the Brenta to the sea, with four Italian armies (the 3d, 4th, 8th, and 12th) engaged, together with British and French forces and one American regiment. Sequisine and Monte Cisen were captured, the Conegliano-Oderzo Road passed, and the Piave crossed at San Dona Piave and east of Zenson. The total of prisoners from the beginning of the offensive aggregated 33,000, with many guns. The operations of the following day marked the beginning of the breaking up of the Austrian resistance. East of the Piave the retreat became general, and progress was made at all parts of the front. 17,000 addition prisoners were reported.

The month closed with the Austrian defense crumbling rapidly and every evidence of impending collapse.

SOUTHEASTERN THEATER

Asia Minor

About the middle of February the Russian forces in Turkish Armenia began to withdraw toward the frontier. Coincident with this movement Turkish troops advanced from the west and occupied the territory which had formerly been denied to them. In their advance they dispersed a number of Armenian irregular bands which attempted to prevent their movement.

The Turkish activity quickly spread to the north, and an offensive was developed along the coast of the Black Sea. On the 20th the force moving along the coast seized the town of Platana just as the Russians were in the act of abandoning it. Pushing on to the east, the Turks occupied the important city of Trebizond without difficulty. This port has been the center of the Russian supply system for much of the army in Armenia ever since it was captured two years ago. With its loss the Russians would have been compelled to evacuate a large part of that region, even had the movement not already been decided upon. Under other circumstances the recapture of Trebizond by the Turks would have been a matter of the greatest importance. As it is they have merely anticipated by a few days the result that must necessarily have followed the withdrawal of Russia from the war.

The Turkish advance eastward into the territory formerly occupied by the Russians, but now evacuated as a result of the conclusion of peace, continues. Erzerum was entered by the Turks about the middle of the month. Numerous massacres of the Armenian inhabitants of the country have been reported. Many of the Armenians are abandoning their homes and taking refuge in Russian territory to the northeast, the flight being covered by bands of Armenian volunteers, who are resisting the advance of the Turks. The bulk of the population of Turkish Armenia was slaughtered or deported in the great massacres of 1915. Most of those who escaped fled across the Russian frontier, but there still remained a not inconsiderable number in the regions conquered by the Grand Duke Nicholas. It is these who are now fleeing to Russia for safety.

The treaty of peace recently signed by the Bolsheviki not only gave up the Turkish territory held by Russian troops, but also ceded to Turkey the Russian frontier governments of Batoum, Kars and Karaband (Karabagh). Many of the Armenian refugees had taken shelter in these sections. A large part of the permanent population of the region is also Armenian. The provinces in question form a part of the Republic of the Caucasus, which declared for local autonomy upon the breaking up of the Russian Empire. This government has declined to recognize the Bolshevik agreement surrendering this territory to the Turks. In addition to the Armenian and Georgian volunteers, who have expressed their determination to resist Turkish domination to the end, the Republic of the Caucasus is possessed of a very respectable army of regular troops. Under the Kerensky régime there was started the transfer to the Caucasian front of all the Armenian and Georgian troops in the Russian army. There are now on this frontier about 250,000 of these veteran troops, said to be in a good state of discipline. It seems probable that the Turks may experience a great deal of difficulty in obtaining possession of the territory which was ceded to them.

The Caucasus

It was reported in a despatch from Moscow on April 4 that Armenian troops had retaken Erzerum from the Turks. If this statement was correct, the success was a short-lived one, as the Turks had completely cleared Turkish Armenia by the middle of the month. They have since been slowly advancing across the former Russian border and taking possession of the provinces ceded to them by the recent peace treaty. Their advance has met with fierce opposition but they are generally gaining control of the whole country. Among the important towns already in their hands are Ardahan, Batoum and Kars.

A despatch from Constantinople, given out on June 13, stated that a treaty of peace had been signed between Turkey and the Trans-Caucasian Government. The latter is the republic that was set up in the Russian Caucasus upon the disintegration of the Russian Empire. After the treaty of Brest-Litovsk had ceded the provinces of Kars, Batum and Erivan to Turkey the Turks proposed a peace to the Caucasian republic and announced that they would recognize the autonomy

EUROPEAN WAR—Continued

of the Caucasian republic in return for certain preferential treatment. After some fighting, peace negotiations were begun early in May. The Turkish troops continued to advance, however, into the territory given them by the Brest-Litovsk treaty. Some of their terms were also considered unacceptable, so the negotiations were broken off. Apparently these differences have now been settled. With no opposition in this region, the Turks will be able to reach the port of Baku, on the Caspian Sea. Once at Baku access to Turkestan and its great stores of cotton will be easy.

It was announced on June 14 that Turkish troops had occupied both shores of Lake Urumiah and the city of Tabriz in northwestern Persia. Since the withdrawal of the Russians from Turkish Armenia the Turks have been gradually working southeast from their old front in order to assist from the left flank the armies driven northward along the Tigris by General Marshall's Anglo-Indian troops in Mesopotamia. At last accounts General Marshall was about sixty miles southeast of Mosul. The new Turkish positions in Persia are some 200 miles northeast of that place.

In the middle of June a German force of 3000 men landed at Poti, a Black Sea port of the former Russian Trans-Caucasia. Poti is connected by rail with Batum, Tiflis and Baku. Later in the month the Germans advanced and occupied Tiflis. This is the largest city in the district, in which there are many Austro-German prisoners. It is reported that these prisoners are now being organized by the Germans into units which will be used to augment the strength of their expedition. There is as yet no indication of the purpose of this German force. It is to be presumed, however, that they have been despatched to this region in order to make sure that the resources opened up by the Russan defection are utilized to the fullest extent.

Macedonia

General Sarrail has been relieved from command of the Allied forces in Macedonia. His successor is General Guillaumat, who was one of the French commanders in the defense of Verdun. No reason for the change has been given out, tho it has been rumored that an increase in the activity in this region is expected to follow the arrival of the new commander. It hardly seems probable that any offensive on a large scale is contemplated due to the difficulty of transporting to this distant theater the immense quantities of munitions which would be required for an advance in country such as is found in southern Serbia and Bulgaria.

It is reported from Berlin that a reconnaissance party of German Jaegers recently discovered that the portion of the Macedonian front heretofore held by the Russian contingent is now occupied by French troops, and that the Russians are apparently not at any other point along the line. While this is the only intimation that the Allies in Macedonia have lost the aid of the Russian troops there, the news does not come as a great surprise in view of the fact that the Russians in all theaters have stopped fighting. While nothing has been given out concerning the strength of the Russian contingent on this front, it has been generally believed that they did not have a very large force. The loss should not be particularly felt unless the Central Powers start an offensive. There is no present indication of such an intention on their part. The line seems to be held largely by Bulgarians, who evince no desire to force the fighting without the support of their allies.

After a long period of almost absolute quiet, the forces on the Balkan front began, during May, to manifest some intention of bringing their inactvty to an end. There are still no signs of major operations, but the raiders and the artillery have been more active than for months. This was particularly noticeable in the bend of the Cerna River, near Monastir, and in the Doiran region. Practically all of the activities were in the nature of trench raids, but in the bend of the Cerna, French and Serbian troops advanced their lines slightly, retaining the positions gained. The Bulgarians made what appeared to be serious attempts to gain ground in the Doiran sector, but their formations were broken up and the attackers driven back before their full intentions became entirely evident.

On May 30 Greek troops, supported by a French contingent, delivered a successful blow on a seven mile front against the Bulgarian line near Skra di Legen, south of the Struma. Mountain positions were penetrated to a depth of over a mile, and 1712 prisoners were taken. Bulgarian counter attacks failed to recover the ground lost.

The minor activities which began in this region during May, after a prolonged period of relative quiet, continued intermittently thruout the past month. On June 1 the Greeks enlarged their gains of the day before west of Skra di Legen, capturing 100 additional prisoners. A series of Bulgarian counter attacks launched during the night failed completely.

French troops supported by Albanians undertook on June 10 the most ambitious operation that has been seen on this front for many months. This was the reduction of the Bulgarian salient which included Mounts Kamia and Lenia. The ground here is very mountainous, presenting summits 6000 feet in height, still covered with snow. The Bulgars resisted stubbornly, and it was not until late in the day, after prolonged hand-to-hand fighting, that the key positions were secured. The occupation of these mountains gave the French extended observation facilities and covered their positions on the heights of Ovravuza. Following this initial success, the movement was extended the next day to cover a front of about eleven miles. Gains were made all along the line, the depth of penetration reaching as much as nine miles at some points. Eleven villages were occupied in the advance, while numerous prisoners and quantities of food and munitions were taken. All of the territory overrun was organized and held against counter attacks.

There has been practically no activity on the Macedonian front proper during July. Aside from the usual artillery exchanges and raiding operations, the only actions were those brought about by a few scattering

local attacks by Bulgarian troops. These took place in both the Cerna and the Struma sectors, but were uniformly unsuccessful.

Farther west, however, on the extension of this front across Albania, the case has been very different. Here the Italians, in conjunction with French contingents and a few Greek troops, have made quite extensive gains. The operation was initiated on July 6, at a time when the maximum advantage could be taken of the Austrian reverse on the Piave and of any shifting of troops from Albania to the north. The Italians adancing along the Adriatic coast were assisted by fire from their own and British monitors.

The enterprise came as a very evident surprise to the Austrians. At the end of the third day the Italians had reached the left bank of the lower and middle Semini River, an advance of fifteen miles. The bridges across this river had been destroyed the day before by a cavalry force which had reached the Austrian rear by outflanking the Malacastra Ridge. As a result many of the defenders were cut off and captured. Farther east the Italians were advancing steadily along both sides of the Osum River. On the 10th the Austrian base at Berat was taken, with quantities of supplies.

While the Italians were advancing northward from Valona and the territory just to the east, the French co-operated by taking up the movement in eastern Albania, pushing to the northwest along the valley of the Devoli. Small bodies of Greek troops and a number of Albanian bands also participated in the operation. The Allied advance appears to have been halted about to 20th. At that time the Austrians had been driven back behind the Semini and Devoli Rivers thruout their length. In the corner of the great northward bend of the Devoli the Italian positions are within twelve miles of the important town of Elbasan in the valley of the Skumbi River.

Thru the Skumbi Valley runs the *Via Egnatia*, the old Roman military road to Thrace and Macedonia. At an earlier stage of the operations in this section, the possession of this line of communications from the coast to the Vardar Valley was of the utmost importance to both of the contending armies. It is still necessary to the Austrians but less so to the Alies, due to the construction by the Italian engineers of an excellent new road from Valona to Monastir.

The Allied policy of keeping the enemy alert on all fronts led to an increase of activity on the part of the artillery, raiders and patrols in Macedonia during August. Particularly was this true in the Struma and Vardar valleys. There were no attempts at serious operations, however.

In Albania the Austrians made several attacks to drive the Italians and French from the territory they had gained during July. Some of these efforts achieved a certain amount of success, but not enough to affect the situation materially. In each instance the attacks were checked before they had attained any great headway, while the Italian counter attacks succeeded in regaining much of the ground temporarily lost. There are no indications that any operations are contemplated in this field on a sufficient scale to warrant much general interest, despite the sudden Allied activity of last month.

Several times since the Allies first collected an army at Salonika in the early fall of 1915, in their abortive defense of Serbia, there have been indications of activity in Macedonia, but very little of real importance has happened. For nearly two years the Allies were practically immobilized by political conditions in Greece, other considerations aside. With the fall of King Constantine in June, 1917, and the establishment of a government favorable to the Allies, the danger of leaving an active enemy in their rear in the event of an advance was removed, but there were other difficulties of a military nature. The character of the country thru which an offensive must be carried on is such that a determined defense would be able to stop any advance unless executed by a considerably greater force, overwhelmingly superior in guns and munitions. Transportation difficulties prevented the Allies from accumulating the supplies necessary to an advance, as it was evident that enemy troops opposed to them would contest every foot of the ground.

Conditions in these respects changed recently. Not only were the Allies able to spare and to transport a greater amount of munitions than formerly, but the enemy in their front had deteriorated in fighting power. At last accounts the Macedonian line was held wholly by Bulgarians with the exception of one German division—the Eleventh. It was known that the Bulgarian nation had become war weary to almost the last degree, and the troops at the front were no exception to this. The resistance to an Allied advance might thus be found much weaker than earlier in the war. Moreover, Bulgaria and Turkey had lately been at loggerheads over the question of their frontier. It was reported that Turkey had concentrated several divisions on the Bulgarian boundary. Bulgaria had undoubtedly followed Turkey's lead in this, still farther reducing her defensive power in Macedonia.

When General Sarrail, who had commanded the Allied forces in Macedonia from the beginning, was relieved by General Guillaumat last December, it was generally thought that the change presaged active operations this summer. The German offensive in France assumed such formidable proportions, however, that the Allies were unable to divert any of their strength to subsidiary fronts. In June of this year General Guillaumat was recalled to take the important post of Military Governor of Paris, being succeeded at Salonika by General Franchet d'Espérey. General d'Espérey thus gained the honor of initiating the first real Allied blow in the Balkans, adding to the laurels he had already won in France.

The offensive was started on Sept 15, when Serbian and French troops, supported by a division of Jugo-Slavs, attacked on a front of ten miles about midway between the Vardar and the Cerna. The Bulgarian front was pierced at once and the attackers stormed the mountains of Teak Vetrenik, Dobropole and Sokol, three of the most important positions on the whole front. The next day the Jugo-Slavs took Mount Koziak, the last and strongest of the series of fortified

EUROPEAN WAR—Continued

peaks, while the French and Serbians pushed ahead along the ridges in their front. German and Bulgarian reserves came into action in an effort to stop the Allied advance but they were put to flight after a desperate struggle. The front of the offensive was now broadened both toward the east and the west. By the 20th the Allies had gained fifteen miles on a twenty mile front and the action was still spreading in all directions. On the 21st the Serbians reached the Vardar north of Kavadar, cutting the railroad and intercepting a number of trains loaded with war material. They also crossed the Cerna and cut the Prilep-Gradsko road. The First Bulgarian Army, based upon Prilep, was thus cut off from the Second Army in the Doiran region, while the supply lines of both had been severed. Prilep was occupied by the French troops from Monastir on the 24th. On the same day the Serbians entered Krivolak and reached the outskirts of Istib, from which the Bulgarians were finally driven on the 25th. On Sept 26 Veles was taken by the advancing Serbs, who now spread their columns to the northwest and the northeast, toward Uskub and the Bulgarian frontier respectively, while they moved directly north more slowly.

In the meantime French and Italian troops had moved out from Monastir to the north and northwest, driving the Bulgarian First Army before them. On the eastern end of the line, the British and Greeks attacking on both sides of Lake Doiran found their first attempts, on the 17th, of little avail. For the first two days they attained very limited successes. Soon, however, the enemy began the evacuation of his lines under the threat farther west, the operation being hastened by the cutting of his line of supply. Within a week the advanced British elements were across the Bulgarian border, moving on the fortress of Strumitza, while other British and Greek troops were forcing their way up the slopes of the Belachitza Range north of Lake Doiran. Strumitza fell on the 26th. Its conquerors turned eastward along the valley of the Struma toward Petrich, their course being paralleled by the Anglo-Greek forces in the Belachitza Mountains.

On Sept 27 Bulgarian plenipotentiaries visited General d'Espérey's headquarters and asked for an armistice. The Allied commander declined to suspend operations, but forwarded the proposal of the Bulgarians to his government. The answer came back promptly from the Allied capitals that no armistice would be agreed upon, and that if Bulgaria desired a cessation of hostilities she must submit unequivocally, the final terms of peace to be settled at the conference when the war as a whole was ended. Austria and Germany rushed reinforcements to their southern ally in an effort to bolster up her courage, but she was definitely set upon surrender.

The capitulation of Bulgaria was consummated on Sept 29, when the Allied commander and Bulgarian delegates signed a convention at Salonika. By its terms Bulgaria is to evacuate immediately all the territory she now occupies in Greece and Serbia, to demobilize her army and to surrender all means of transport to the Allies. She concedes to the Allies the right of free passage thru Bulgaria for the development of military operations, and will surrender to them her boats and control of navigation on the Danube. All Bulgarian arms and ammunition are to be stored under the control of the Allies, to whom is conceded the right to occupy all important strategic points.

This armistice, which is to remain in force until a final general peace is concluded, means a complete military surrender. Its effect upon the general situation has been discussed elsewhere in this review. It is understood that the reoccupation of Greece and Serbia is to be accomplished by Greek and Serbian troops, while Bulgaria will be occupied by forces of the other Allied powers.

Mesopotamia

The evacuation of Armenia and Persia by the Russians constitutes a serious menace to the British expedition in Mesopotamia. With the support of their former allies withdrawn, the British right flank will be in the air. To make the flank secure would require an extension of the front which the force at its present strength could not accomplish without seriously weakening the line thruout. Should the Turks attempt operations against the expedition, there appears nothing to do but fall back for many miles unless Britain can send material reinforcements to offset the defection of the Russians. It appears doubtful that it will be considered feasible to place upon this minor front any considerable additional force.

Despite the probability of difficulties which may be encountered in the near future, the British have as yet evinced no intention of retiring. Indeed they have advanced several miles on the Euphrates. The troops which have been occupying Ramadieh since its capture last fall took Khana Burayet, fourteen miles west of Ramadieh, on Feb 20. Their advance guard penetrated to within eighteen miles of Hit, one hundred miles west of Bagdad. The Turks offered little resistance to the movement.

The very evident menace to the British Mesopotamian Expedition caused by the Russian retirement and consequent Turkish advance in Armenia has been previously pointed out. The danger is becoming constantly greater. Recent unofficial reports have stated that Turkish units under German leadership are advancing in the region of Teheran. It has been further rumored that there is a strong possibility of the Persians espousing the cause of the Central Powers. This would, of course, add materially to the difficulties of the British in Mesopotamia.

Despite the menacing outlook, the British have not stopped their advance up the Euphrates, begun in February. On the morning of Mar 9 they occupied Hit, 80 miles west of Bagdad. The Turkish garrison retreated rapidly up the Euphrates, being pursued by British airplanes, which caused severe casualties by means of bombs and machine gun fire, some of the planes operationing at a height of only 100 feet. The main British forces followed the retreating Turks by forced marches, finally coming up to them and completely routing them with the capture of

3000 prisoners. The advance was continued and by the end of the month the British had reached a point 45 miles above Hit.

The British column which pushed up the Euphrates last month continued to advance during the early days of April. Since then there has been no mention of this operation in any of the reports. At last accounts the British had reached a point eighty-three miles up the river from Hit.

In the last days of the month the British started a movement in several columns northward from their positions on the Tigris in the direction of Mosul. The main column moved along the principal road thru Kifra and Kirfuk. The first of these towns was taken on the 27th, the Turks avoiding attack and retreating on Kirfuk. The next day the British infantry reached the Aqsu River, a passage over which had already been forced by the advanced cavalry. On the 29th the cavalry got across the Turk's communications toward Taug, while the infantry took the town of Tuzhurmatli with many prisoners. As the month closed the British were pursuing the enemy along the main road to the north. About 1900 prisoners, five guns, and some transport had been captured.

The British expedition which started northward in the general direction of Mosul in the latter part of April continued to advance during the first days of May. Kerkuk, about 80 miles southeast of Mosul, was entered on May 7 without opposition, the Turks retiring to the north. British mounted troops pursued the retreating enemy, capturing two guns and many prisoners. On May 11 the Turks were driven across the Lesser Zab River at Altyn Kupri, twenty miles north of Kerkuk. During this same period another British expedition captured Kifri, southeast of Kerkuk. The two columns together took about 3000 prisoners and 16 guns in these operations. According to a Turkish despatch, the British retired from Kerkuk toward the south in the last days of May, the town being reoccupied by the Turks. It seems doubtful, however, if the British will abandon much of this territory at this time without being forced to do so. By means of the expeditions up the Tigris and the Euphrates, the most fertile districts of Mesopotamia have been denied to the Turks at the time when the crops are just ripening. Such being the case, the country would hardly be evacuated without destroying the crops. That there has been any attempt to do this does not appear from the despatches. The reported appearance of Turks and Kurds south of Lake Urmia may account for the alleged British retirement.

The Mesopotamian theater, quiescent until late in October, broke into activity coincident with the successes of Gen. Allenby in Syria. The British forces began an advance on both banks of the Tigris from Bagdad in the direction of Mosul on Oct 24, the initial operation being the capture of Kerkuk. Hard fighting followed, which terminated in the capture of the entire Turkish force on the Tigris on Oct 30. The prisoners were reported at 7000 with much matériel captured. The Turkish commander, Ismail Hakki, surrendered with one entire division and parts of two others, according to press reports.

Operations were terminated by the armistice signed by Turkey on Oct 31, granting access to the Dardenelles to Allied warships, and withdrawing all Turkish military forces from the war. An unusual feature of the armistice was the sending by the Turkish government of Gen. Townshend, the British commander captured at Kut-el-Amara, to ask for the granting of the armistice.

Palestine

The offensive of the British expedition in Palestine has continued to meet with success. With the occupation last month of the positions to the west of Jerusalem, operations by the main body of the expedition were suspended for a few days. The right wing, which had been held up south of Hebron, was strengthened and started northward. Hebron was quickly taken by direct assault. Pushing rapidly on thru Bethlehem, the force closed in on Jerusalem from the south and east. In the meantime the left wing had gradually worked north of the city. On Dec 8, the British attacked Jerusalem from the south and west. The Turkish garrison resisted manfully, but outnumbered and with their retreat cut off, they had no chance and finally surrendered. The British entered the city on the 11th. The attack was made without artillery support in order to avoid damage to the city and its surroundings, so rich in historic interest.

The capture of Jerusalem by the British ends a continuous possession of the city by the Turks since the year 1244. Indeed the Holy City of the Christians has been in Mohammedan hands practically all of the time for the last 1200 years. For two short periods the city had Christian rulers but in each case it soon reverted to Mohammedan dominion.

The British were not left to occupy their new positions in peace. The Turks were not in sufficient force to attempt serious attacks against them, but instead split up into small bands and engaged in guerrilla warfare, sniping outposts, attacking patrols, and in general making as much trouble as possible. The hilly country around Jerusalem, cut up by numerous ravines and small streams, is well adapted for tactics of this kind. It was decided to move the British lines farther north to secure more favorable terrain. The Turks resisted stubbornly but the British steadily pushed on. At the end of the month they had reached an east and west line thru Bireh, nine and one-half miles north of Jerusalem. In the meantime the troops on the coast had crossed the Nahr-el-Auja, four miles north of Jaffa, and had seized the commanding ground three miles north of that stream.

The British in Palestine have remained practically quiet during January. A few slight gains were made north of Jerusalem, but these were rather extensions and rectifications of their position than an advance properly speaking.

It has been reported for some months that General Falkenhayn was assembling in the vicinity of

EUROPEAN WAR—Continued

Aleppo a strong Turkish force with a nucleus of German troops and a liberal sprinkling of German officers. The original purpose of this concentration was thought to be the recapture of Bagdad, and the expulsion of the British forces from Mesopotamia. With the rapid advance of General Allenby's expedition in Palestine the belief grew that Falkenhayn's force would probably be diverted from its first objective, and turned southward instead. It is now reported that the Turks in this command have become greatly disgruntled with their treatment by the Germans, that many of the officers have resigned their commissions, and that about half of the troops have deserted.

It was announced on Jan 28 that an Arab force had attacked the Hedjaz railroad at a point about fifty miles southeast of the Dead Sea. After destroying several miles of the line, the Arabs retired. The continued possession of this railroad by the Turks is a constant threat against the British in Palestine. It would greatly increase the security of General Allenby's command if the Arabs could continue their operations against the line, and force the Turks to fall back to the north.

In a series of brilliant attacks on Feb 19, 20 and 21, the British Palestine expedition cleared the Turks from the territory they had been holding west of the Dead Sea. The attacks were delivered along a twelve mile front east and northeast of Jerusalem. For the first two days the Turks resisted stubbornly but were gradually forced back. After the country between Jerusalem and the Dead Sea had been cleared of the enemy, the British took Jericho, fourteen miles north of Jerusalem, with little opposition, on the 21st. The Turks then fell back to the east bank of the Jordan as far north as the Wadi Auja. The lines are now established along these streams.

The importance of the capture of Jericho lies in the fact that it is a junction of a number of roads, the only means of communication in the region. The Turks have now been deprived of the lines along which they could formerly quickly move troops from one point to another. In addition to several minor roads, there was one main highway running north and south thru Jericho, and another extending east and west. The latter crossed the Jordan on a large concrete bridge, built since the beginning of the war under German supervision. The Turks have now lost this crossing, and their forces on the east and west banks of the Jordan can no longer co-operate with the freedom they formerly enjoyed.

The difficulties of the Turks have been multiplied by the activities of the Arabs, who have continued to make raids on the Hedjas Railroad, east of the Dead Sea.

The British in Palestine have made very appreciable advances during March. Each gain has been for a relatively short distance, but in the aggregate they have accounted for a marked shifting of the lines. Late in Feb, following the capture of ancient Jericho, the British had reached the right bank of the Jordan. In the early days of March they pushed across the river at a number of points and established bridgeheads, but did not push their successes. During this same period several advances were made west of the Jordan and in the coastal region.

There now ensued a fortnight of comparative calm. On Mar 22 the British started a determined offensive east of the Jordan, accompanied by several heavy blows to the west of that stream. On the 22nd and 23rd the bridgeheads on the left bank of the river were extended and improved. On the night of the 23rd new bridges were thrown across the Jordan, whereupon fresh troops were moved to the left bank, and an advance in force was undertaken. By the night of the 24th the head of the advancing columns had left the river nine miles in rear. The progress thru the difficult mountainous country was opposed by both Turkish and German troops, prisoners of both nationalities being taken. At latest reports the British were closing in on Amman, about 25 miles east of the Jordan. Mounted troops reached the Hedjaz railroad and destroyed several miles of track.

The cutting of the Hedjaz railroad severs the communications of the Turks with their forces in the region souheast of the Dead Sea and with those in western Arabia. The Arabs who are in revolt against the Turks have for some time been masters of the lower part of this railroad, cutting the northern communications of the 39th Turkish Division, which has been investing Aden since July, 1915. The latest British success isolates the Turkish troops which have been operating against the Arabs.

West of the Jordan General Allenby's command now occupies a line some 60 miles in length, extending from Arsuf, on the coast, in a general southeasterly direction to the river at a point about 30 miles north of Jerusalem. Some observers see in the northward movement of the Palestine expedition and the advance of the troops from Mesopotamia up the Euphrates a concerted threat upon Aleppo, the important Turkish base. If such be indeed the plan, the danger to Aleppo is not acute, as both British forces are now about equidistant from that city and over 250 miles away.

There has been less activity in Palestine during April than for some time past. The British column which pushed east from the Jordan late in March was apparently no more than a raiding party as later British reports stated that these troops had been withdrawn nearer to the Jordan, their purpose of cutting the railroad having been accomplished. The Turks, who seem to have been reinforced by German units, delivered several attacks during the month at different points along the line, but made no gains. The British advanced slightly north of Jerusalem. On the whole, however, the situation was practically unchanged.

General Allenby's operations east of the Jordan, threatening as they did the Hedjaz Railway, quickly

brought about a heavy counter on the part of the Turks. A considerable body of troops was assembled and the British, who had advanced to Es-Salt, were attacked in force. Repeated assaults were made thruout the first three days of May. Tho all of these attacks were repulsed, the British evidently found the situation not to their liking, as they began to withdraw on the night of the 3rd. The bulk of the British forces were drawn back to the west bank of the Jordan, strong detachments being left on the east side to secure the principal crossings. During these operations the British captured one German and 49 Turkish officers, 42 Germans, 843 Turks, 29 machine guns and 6 motor trucks, besides inflicting casualties on the enemy considerably in excess of their own.

Altho General Allenby was forced to abandon the territory he had secured on the east side of the Jordan, the main object of his movement was realized. This was to draw Turkish troops from the south and so ease the situation for the Arabs, who were being rather severely pressed in some localities. To such a marked extent were the Turks attracted to the Es-Salt region that the pressure was almost entirely taken from the Arabs. The latter have taken full advantage of the situation, and during the remainder of May they have engaged in a continual succession of raids against the Hedjaz Railway. Garrisons have been captured, and stations, track and bridges destroyed until the entire line is now virtually out of commission. The Turkish and German troops to the south have thus had their line of supplies definitely cut. They are reported to be living upon dates and whatever else they can obtain locally, which is not much as the country thereabout is far from productive.

On the night of July 13 a strong force of mixed Turks and Germans attacked the British positions covering the passages of the Jordan and on the Abu Tellul ridges north of Jericho. The ridge positions, at first penetrated, were entirely restored by a counter attack, in which over 500 prisoners, more than half of whom were Germans, surrendered to the Australian and New Zealand troops. On the river front the Turks apparently attained a greater success. Details are not available, but the Turkish reports claim extensive gains, with the infliction of heavy losses upon the defenders.

General Allenby's Palestine Expedition, after a period of quiet during the hot summer months, resumed active operations almost exactly six weeks earlier than last year. The new offensive, admirably planned and as admirably executed, was most ambitious in scope. It depended chiefly upon the employment of cavalry on a larger scale than anything recently attempted. In the formulation of such a movement General Allenby's earlier training as a cavalry officer stood him in good stead.

During the night of Sept 18 British and Indian troops advanced between the Jerusalem-Nablus road and the Jordan, cutting the roads leading to the southeast from Nablus. At 4:30 the following morning the main attack was launched on the other extremity of the line, from Rafat to the sea. By 8 o'clock the entire defensive system on this front had been overrun, the assaulting troops advancing to a depth of about five miles, when a portion swung east to roll up the remainder of the Turkish line. The balance of the attacking infantry kept on to the north. By evening they had occupied the railroad junction of Tul Keram.

As soon as the Turkish line from Rafat to the coast had been pierced by the infantry, the cavalry pressed forward in several strong columns. One brigade of Australian light horse spread out along the main Tul Keram-Messudieh railroad and the road in the vicinity of Anesta, cutting off large bodies of the retreating enemy, with their guns and transport. The bulk of the cavalry continued northward along the coastal plain for about fifty miles and then turned eastward, cutting the lines of retreat of the Turkish main body. By Sept 21 these flying columns had taken Nazareth, El Afule and Beisan, and occupied all the country to the southwest of Lake Tiberias, the ancient Sea of Galilee. The Turks now had no avenue of escape except eastward across the Jordan River. The British cavalry working southward and the infantry pressing to the north along the Jordan soon closed even this exit. With the capture of the crossings at Jisr-ed-Dameer the entire Turkish army west of the Jordan was surrounded. A relatively small number of Turks escaped before the routes across the river were closed and joined the forces east of the Jordan. With this exception the whole main army was forced to surrender. On the 26th it was announced that over 48,000 prisoners and 350 guns had been captured. The commander of the Turks, the German General Liman von Sanders, barely escaped capture by a hasty flight from Nazareth just before it was entered by the cavalry, leaving his command to its fate.

The minor Turkish force to the east of the Jordan, with the fugitives from the main army who had joined it, was not long to escape the general catastrophe. At the opening of the offensive on Sept 19, an Arab raiding party had descended upon the junction north of Derat on the Hedjaz railroad. Spreading out from this point, the Arabs had effectually destroyed the tracks to the north, west and south. Thus debarred from a movement toward Damascus, the Turks in the Es-Salt region fell back to the southeast upon Amman on the railroad. A force of British cavalry was soon upon their heels, driving them from Amman and south along the railroad. But in the meantime the main Arab army of the King of Hedjaz had seized the station of Ma'an and started northward. The Turkish Fourth Army was thus in a hopeless position. A large number of prisoners had been taken at Amman. On the 29th, 10,000 more men were captured south of Amman at Ziza. The capture or dispersion of what remains of this force can be but a matter of days.

The Turks are reported to have had something over 80,000 men in Palestine. Nearly three-fourths of this number have already been taken prisoner. The losses in killed have been comparatively slight, but for all practical purposes the force has been annihilated. Small bodies of troops were in the areas to the north of the section surrounded by the British and these are reported to be resisting in places, but in effect Allenby is at present unopposed. As early as the 23rd Haifa

EUROPEAN WAR—Continued

and Acre, on the coast west of Nazareth, were occupied with little difficulty. As the month closed a part of the British force was moving slowly northward to the west of Lake Tiberias, having reached a line a little north of the lake. The slight opposition encountered was apparently giving no trouble. East of Lake Tiberias a column of cavalry and armored cars moved rapidly northward along the Hedjaz railroad, followed by infantry. On Sept 30 the cavalry occupied the hills overlooking Damascus from the south. Advanced patrols entered the city but withdrew that night, tho evidently not under pressure.

The month opened with Gen. Allenby's forces moving northward with little opposition from the Turks. Damascus with a garrison of 7000 troops, was captured Oct 1. An Australian division penetrated the city the preceding night. Occupation of the city was carried out by British troops and by a portion of the Arab army under King Hussein.

Damascus is 160 miles from Jerusalem and 90 miles from the starting point of Gen. Allenby's advance on Sept 14.

Press dispatches via Switzerland announced on Oct 8 the resignation of the Turkish cabinet, and with it Enver Pasha, the Minister of War, who was the staunch supporter of Germany.

By Oct 10, the Beirut-Damascus railway had been crossed and Beirut taken by French naval and military forces. This gave Gen. Allenby a new and more convenient base for further northward movement, which was marked by the occupation of Tripoli on Oct 13, and Homs on Oct 15.

Continuing the steady northward movement, Gen. Allenby reached Aleppo Oct 25, which was occupied by cavalry and armored cars with little opposition. Liman von Sanders had a force of about 12,000 to defend the city, but he gave up the idea and retired to the north on Gen. Allenby's approach.

The capture of Aleppo was the crowning achievement of Gen. Allenby's campaign, as it gave control of the important railway junction just north where the Damascus branch leaves the main line from Constantinople to Bagdad. The line of supply and communication of the Turkish force operating in Mesopotamia was thus broken, and the troops there placed in a precarious position.

Serbia-Saloniki Front

The collapse of Bulgaria became complete with the signing of the armistice on Sept 29. The terms of this armistice have already been given. In carrying them out, it is reported that Bulgaria will be occupied by British, French, and Italian forces, the evacuated portion of Greece by Greek troops, and of Serbia by Serbian troops.

The surrender of Bulgaria has an important influence upon the situation in that it blocks communication between Germany and Turkey.

The possibilities of decisive military operations against Germany from this quarter need hardly be discussed. There are many other avenues of approach involving fewer difficulties of communication and transport.

Following the withdrawal of the Bulgarian troops from the Salonika front, D'Espérey's force conducted a vigorous pursuit of the Austrian and German units that had been operating with the Bulgarians. Lakochtitza and Svodie were reached Oct 9. A stand was attempted at Godilice pass, where 2000 prisoners were captured.

In Albania, the Italian troops followed up the Austrian withdrawal. Berat was occupied without opposition Oct 3, and Elbasan was occupied on Oct 7.

Gen. D'Espérey continued his rapid advance northward with little opposition. A delaying action on Oct 11, was followed by the occupation of Nish on Oct 12, thus severing direct rail communication between Berlin and Constantinople. Forty-four field guns and a considerable amount of other booty were captured at Nish. The Italians continued northward and forced Straba Pass Oct 13. Durazzo was captured the next day. Oct 17, the Serbians occupied Alexinatz and Zlatare. 32 guns were captured in these operations.

By the close of the month, the reoccupation of Serbia and Albania was practically complete. Serbian forces were in contact with the Teuton rear-guards in the valley of the Morava Oct 25. Kraguievatz was captured on Oct 27. The Italians reached Alessio the same date.

AFRICAN THEATER

East Africa

Operations have once more been undertaken against the German force which retreated into Portuguese East Africa when the defense of German East Africa was broken down. A column under Brig. Gen. Edwards moved westward from Port Amelia at the same time that another commanded by Maj. Gen. North advanced eastward from Lake Nyasa, the two converging on the German headquarters at Nanungo.

Gen. Edwards entered Nanungo on May 19 without opposition, the Germans retreating to the southwest in the direction of Manua. On May 22 the leading troops of the two British columns engaged the main body of the Germans and drove it westward. By the 28th the refugees had been pushed south of the Lurio River, having suffered substantial casualties and lost a great amount of equipment. A Portuguese column is south of the Lurio for the purpose of co-operating with the British. Word has not yet been received as to whether or not they have come into contact with the retreating Germans.

German East Africa

Operations have been started against the German force which retreated into Portuguese territory from German East Africa at the conclusion of the campaign in that region. Three British columns have taken up the pursuit; one along the coast, a second moving east from the southern end of Lake Nyasa, while the third is working up the valley of the Lujenda River. Contact with the Germans has

been gained momentarily, but they have evaded combat thus far.

NAVAL OPERATIONS

The United States destroyer *Jacob Jones* was sunk by a submarine on Dec 6. When the vessel was struck the guns were immediately manned, but no submarine was sighted and, as the destroyer began to settle, she was abandoned. Forty-five of the crew were saved, sixty-four men not being accounted for. Reports from Berlin state that two survivors were picked up by the submarine and taken back to Germany. The *Jacob Jones* is the first American war vessel to be sunk by the enemy.

A Copenhagen dispatch of Dec 5 stated that the German guard ship *Botnia,* stationed at the southeastern end of the island of Amager, was blown up by running into the German mine field in that vicinity. The *Botnia,* an auxiliary cruiser, was formerly a Russion vessel which had been captured by the Germans.

In a daring raid on the night of Dec 9 some Italian torpedo boats slipped thru the mine defenses of the harbor of Trieste and fired four torpedoes against two Austrian warships. All the torpedoes struck and exploded. As Vienna reported the torpedoing of the battleship *Wien* on the night of Dec 9, this is probably one of the vessels struck in this raid. All the Italian boats returned to their base in safety.

On Dec 12 four German destroyers attacked a convoy accompanied by two similar British vessels. The British destroyer *Partridge* was sunk and the *Pelew* was damaged. Four mine sweepers and six of the neutral merchantment in the convoy were also sunk. A court of inquiry has been called by the British Admiralty to ascertain the cause for the absence of the force that had been detailed to protect the convoy against surface attacks. On the same day a trawler and two merchant vessels were sunk off the Tyne by German destroyers, probably the same ones that attacked the convoy.

The French protected cruiser *Châteaurenault,* in use as a transport in the Mediterranean, was torpedoed and sunk on the morning of Dec 14. The submarine which attacked her was herself destroyed by gunfire from French warships and by bombs from seaplanes.

Three British destroyers were sunk thru being hit by torpedoes or striking mines off the Dutch coast during foggy weather on the night of Dec 22. A total of 13 officers and 180 men were lost.

It was announced on Dec 14 that an Allied Naval Council had been formed "to insure the closest touch and complete co-operation between the allied fleets." France, Great Britain, the United States, Italy, and Japan .ill be represented on the council.

A U-boat Department has been added to the German naval administration for the period of the war. The new department will deal solely with U-boat affairs, which heretofore have been handled by the dockyards section of the Navy Department.

On Dec 26 Vice-Admiral Sir Rosslyn Wemyss was appointed First Sea Lord in succession to Admiral Sir John Jellicoe. Admiral Jellicoe was elevated to the peerage in recognition of his distinguished services. He has been in the Admiralty for the last 13 months, coming there from the command of the Grand Fleet. Admiral Wemyss has been his assistant.

It is announced by the British Admiralty that the hospital ship *Rewa* was torpedoed and sunk in Bristol Channel on the night of Jan 4. All the wounded were saved, three members of the crew being all that were lost out of 550 persons on board. Berlin states that the vessel must have struck a mine as she was not torpedoed, but the British insist that the sinking was caused by a torpedo and not by a mine. The Rewa was displaying all the lights and markings specified for hospital ships. This is the first British hospital ship to be torpedoed since the German Emperor accepted the conditions under which they should be used.

The British destroyer *Raccoon* struck a rock off the coast of Ireland on Jan 9, and went down with all hands. Two other destroyers were lost off the Scotch coast during a heavy gale and snow storm on Jan 12. Only one man was saved from the crews of the two vessels.

On the morning of Jan 20 the Turkish battle cruiser *Sultan Yawuz Selim* and armored cruiser *Midulla,* formerly the German *Boeben* and *Breslau,* respectively, issued from the Dardanelles, and attacked the British naval forces north of the island of Imbros, consisting of two old monitors and some destroyers. The British monitor *Raglan* and the small monitor *M-28* were sunk by the fire of the Turkish vessels, which were manned by Germans. The cruisers then proceeded south of Imbros, where the *Midulla* was driven into the British mine field, struck a mine, and sunk. Her consort immediately steamed at full speed for the Dardanelles. As the *Selim* neared the entrance, she too struck a mine. She was so badly damaged that she had to be beached on the west side of Nagara Point at the narrows. Here she was bombed by British seaplanes, but the Turks were finally able to patch her up sufficiently to take her on up the channel to Constantinople.

The German destroyer *A-79* struck a mine and sank off the coast of Jutland on Jan 20. The *A-73,* hastening to the aid of the stricken vessel, also hit a mine and went down. The other three vessels of the flotilla, fearing the same fate, hastily left the scene. Only seventeen men were saved from both crews.

It was reported on Jan 23 that the British transport *Aragon* had been torpedoed and sunk in the eastern Mediterranean on Dec 30. A destroyer engaged in picking up survivors was likewise sunk. The next day the auxiliary steamer *Osmanieh* struck a mine and sank in the same vicinity. Over 800 persons were lost altogether.

On Jan 28 the British torpedo gunboat *Hazard* was sunk in the English Channel as a result of a collision.

To Americans the oustanding naval event of the month was the sinking of the British steamer *Tuscania*

EUROPEAN WAR—Continued

en route from the United States with 2192 American troops on board. The *Tuscania* was torpedoed by a submarine off the north coast of Ireland on the night of Feb 5. Under the circumstances, the loss of life was very small, the total being 204 according to the latest reports. This is the first vessel carrying American troops to France that has been sunk. It is to be expected that a certain percentage of losses will be incurred in this way, but the figure should be small if the experience of Canada in transporting troops to Europe may be taken as a criterion.

At one a. m. on Feb 15, a German destroyer flotilla made a sudden descent on the British light patrol in the Straits of Dover. The patrol was engaged in hunting down a submarine which had been sighted. Being only lightly armed, the British vessels were helpless when the Germans got among them. One trawler and seven drifters were sunk. The raid was evidently made with the object of interfering with the British submarine warfare, which has been exceedingly successful of late. It has been asserted that twenty per cent of the German submarines leaving port fail to return.

On the night of Feb 16 a German submarine bombarded the city of Dover for several minutes. Some damage was done to private property. One child was killed, and three men, one woman and three children were injured.

Copenhagen reported, on Feb 20, that a German guardship in the Baltic had struck one of its own mines, with a resulting loss of twenty men.

The British hospital ship *Glenart Castle,* outward bound and with all lights burning, was torpedoed and sunk in Bristol Channel early on the morning of Feb 26.

A German despatch states that after cruising for fifteen months in the Atlantic, Pacific and Indian Oceans, the auxiliary cruiser *Wolf,* one of the most successful commerce destroyers of the war, arrived safely at home on Feb 24. The *Wolf* captured eleven vessels during her long cruise. One captured vessel, the British steamer *Turitella,* was converted into a second cruiser, and operated in the Gulf of Aden. The *Turitella* was finally run to earth by a British cruiser, and her crew captured after they had sunk their vessel. During the *Wolf's* many months at sea she was wholly dependent for coal and supplies upon the vessels she could capture.

The losses in merchant vessels due to the activities of the German submarines continue to be one of the most serious problems of the war. Official figures recently given out show that from the beginning of the war to the end of 1917 the total loss among the merchant vessels of the world outside the Central Powers was 11,827,572 tons. During the same period the mercantile shipbuilding output was 6,606,275 tons. There have been captured and put into service 2,589,000 tons of enemy vessels. The net loss of non-Germanic shipping is thus 2,632,297 tons. During the year 1917 alone the U-boats sank more tonnage than the Allies and neutrals have built since the beginning of the war. The shipyards have now begun to gain on the submarines, however, and Sir Eric Geddes has stated that the U-boats are being sunk as rapidly as they are being built. It is estimated that the total existing non-German tonnage is about 42,000,000. During the past month the Allies have commandeered and put in service all the Dutch vessels which were laid up in their ports, thus adding to the tonnage in active operation.

A German torpedo-boat and two mine-sweepers were sunk by mines off Vlieland Island (Holland) on Mar 1.

On Mar 10 the British hospital ship *Guilford Castle,* inward bound with 450 wounded from East Africa on board, was attacked by a submarine at the entrance to Bristol Channel. The first torpedo missed, but the second one struck the vessel in the bow. She nevertheless managed to make Avonmouth, where the wounded were landed. The *Guilford Castle* was flying Red Cross flags and had all the prescribed hospital ship markings.

The explosion of a depth bomb on board the United States destroyer *Manley,* when that vessel was in collision with a British warship in European waters on Mar 19, resulted in the death of one officer and fifteen enlisted men. The *Manley* reached a British port safely, tho in a damaged condition.

In the early morning of Mar 21 two British and three French destroyers engaged a force of German destroyers and torpedo-boats which had been bombarding Dunkirk. Two German torpedo-boats were sunk and it is thought that two destroyers were either sunk or severely damaged.

A British destroyer was sunk in a collision on Mar 23, only two men being lost.

A German transport carrying troops to the Aland Islands struck a mine and sank on Mar 23. The passengers were rescued by another transport, the *Frankland,* which shortly thereafter herself struck a mine and sank. She was heavily laden with troops, guns and munitions. According to reports there were no survivors.

The German submarine *U-48,* which sought refuge in the port of Ferrol, Spain, was interned on Mar 25. Her guns and ammunition were taken out and her propellors unshipped.

According to the British Admiralty, eight German submarines have been sunk in the English Channel by bombs dropped from seaplanes, while two more have been similarly accounted for by dirigibles.

Petrograd announced on April 12 that the Russian fleet, which has been laid up at Helsingfors, altogether about 200 vessels, has escaped the threatened capture by the German forces operating in Finland. The capital ships hal already arrived at Kronstadt when the despatch was sent, the destroyers and submarines were off that naval base, while the miscellaneous vessels were expected within a few hours. This settles the speculation as to what the

Germans would do with the Russian fleet should it fall into their hands.

The only important naval event of the month, and one that must be regarded as one of the most brilliant enterprises of the war, was the daring raid of the British naval forces upon the submarine bases of Ostend and Zeebrugge. The raid was made for the purpose of bottling up the entrance channels of the two ports. A considerable measure of success attended the attempts at both points.

The attacks were made under cover of a dense smoke screen such as has been developed in the campaign against the submarines. The operation at Zeebrugge was the more extensive of the two. Here the old cruiser *Vindictive* was run against the mole on the outer side of the harbor and landed a storming party, which attacked the German troops there, at the same time blowing up all the defenses that could be reached. Under cover of the commotion caused by this attack, three other vessels filled with concrete were headed into the channel entrance. Two of these were blown up and sunk directly in the channel. The third grounded on a shoal near the entrance and so was not entirely effective. It is thought, however, that the channel was blocked. At the same time that these other events were taking place a submarine loaded with explosives was run against the shoreward connection of the mole and there blown up. A great gap was opened up by this explosion.

At Ostend the operation was simpler, but apparently also met with success. Two block ships were blown up in the channel here. The whole operation was supported by the fire of a covering force of light vessels which lay offshore.

In the naval raid upon the German submarine bases at Zeebrugge and Ostend on Apr 23, the British were less successful in blocking the channel at the latter place than they were at the former. As the two towns are connected by a canal capable of carrying a submarine, it was necessary to block both channels if the maximum of benefit were to be derived from the operation. A second raid was accordingly made on the harbor of Ostend on the night of May 9. The obsolete cruiser *Vindictive,* which had played such a prominent part in the former raid, was used as the blocking vessel in this instance, having been filled with concrete in the interim. The Germans were on the alert this time and the *Vindictive* was under fire for some minutes before she reached the desired place in the channel. Her crew managed, nevertheless, to place her between the piers at the sides of the channel and there sink her, escaping with slight casualties. It has since been reported from Berlin that the *Vindictive* has been moved alongside one of the piers and that the channel is once more free.

In a brilliant feat on the morning of May 14, Italian light forces succeeded in entering the harbor of Pola and torpedoing an Austrian battleship. The vessel torpedoed was stated to be one of the *Viribus Unitis* type. At the beginning of the war there were four battleships of this type in the Austrian navy. They were the most powerful vessels possessed by the Austrians, having a displacement of 20,000 tons. During the attack on the battleship Italian seaplanes attacked Austrian machines over Pola. It was stated that two Austrian planes were shot down and several others forced down out of control, while the Italian machines all returned in safety.

A British destroyer was torpedoed and sunk by an enemy submarine on May 14. Two men were lost.

The German submarine *U*-39 entered the port of Cartagena on the night of May 18 in a seriously damaged condition as a result of a battle. The *U*-39 was accompanied to the entrance to the harbor by another submarine. She was being guarded by a Spanish cruiser at last accounts, the crew being forbidden to communicate with the shore. It is believed, however, that she will be forced to intern. It will be remembered that it was the *U*-39 which torpedoed the *Lusitania.* It is not improbable that this is a new vessel with the old name, as she is reported to be 220 feet long, with a crew of thirty men. This is rather larger than the German submarines were thought to be in 1915.

It was announced on May 20 that a French trawler had sunk a German submarine and had taken the entire crew prisoner. On May 25 the British Admiralty announced the sinking of a German submarine of the cruiser type. This being the first of the cruiser submarines to be sunk, the Admiralty departed from its usual custom of not announcing individual sinkings.

The British armed troopship *Moldavia* with American troops on board was sunk by a submarine on May 23. Fifty-six men were lost. The transport *Leasowe* was similarly sunk in the Mediterranean on May 26, with a loss of 101.

As has been rather expected for the past year, German submarines have at last brought the war to the coast of the United States by sinking vessels just off shore at various points from Cape Cod south. The sinkings began late in May, but it was not until June 2 that the fact became known. For several days the reports of vessels sunk were constant and numerous. The Navy Department took prompt action in an effort to locate the submarines and protect shipping. All available vessels were sent out to comb the seas as soon as the presence of the intruders became known. The number of submarines that participated in the raid is not known but it seems to be established that there were at least two. After the middle of the month the sudden cessation of sinkings appeared to indicate that the submarines had left. The fact that the last sinking occurred over 500 miles off the coast bears out this idea. The exact number of vessels sunk may never be definitely established. It is known, however, that twenty-two fell victim to the undersea craft.

The Germans are still badly handicapped by the British success in blocking the submarine base at Zeebrugge. Aerial photographs taken about the middle of June show that the entrance to the harbor is rapidly silting up. It appears that the large dredge that was in constant use to maintain the channel was sunk during the attack, which has crippled the German attempts to keep the harbor open.

One of the most remarkable successes in sea actions during the war was gained by two small Italian motor

EUROPEAN WAR—Continued

torpedoboats on June 10. While cruising along the Dalmatian coast on the way back to their base from a patrol, the crews of the torpedoboats sighted two Austrian battleships escorted by destroyers. Dashing thru the protecting destroyer screen, the motor boats attacked the battleships with torpedoes. One of the superdreadnoughts was sunk and the other damaged. The Italians then fled for their base pursued by the destroyers. The leading destroyer was seriously damaged by the explosion of a depth bomb dropped by the fugitives, who succeeded in making good their escape. The sunken vessel, the 20,000 ton *Szent Istvan,* was the newest of the first-line Austrian battleships, having been completed since the beginning of the war. This makes the third Austrian dreadnought that the Italians have sunk by their brilliant torpedo work.

July has been an exceptionally successful month for the German U-boats, altho the total tonnage sunk has been the least for two years. In no former month since the beginning of the war have they accounted for as many transports and kindred vessels essential to the Allies. On July 1 the American transport *Covington,* formerly the *Cincinnati* of the Hamburg-American line, was torpedoed and sunk while returning to the United Statese without passengers. All the officers and crew were rescued with the exception of six men. The American army supply-vessel *Westover* was sunk in the war zone on July 11 while bound for France. Ten officers and men were lost from her crew of 92.

On the 15th the British troops steamer *Barunga,* formerly the German *Sumatra,* was torpedoed while bound for Australia with several hundred disabled soldiers. There were no casualties, as the vessel remained afloat nearly an hour after being struck, affording ample time for the rescue of all aboard. Two days later the 13,600 ton Cunard liner *Carpathia,* which has been in use as a troop transport, was sunk off the Irish coast by a German submarine. She was bound for the United States, having just landed a contingent of American troops. Five of the crew lost their lives in the engine room when the vessel was torpedoed. The remainder of the 220 persons on board were saved.

The heaviest loss of the month was the sinking of the White Star steamship *Justicia,* of 32,100 tons burden and capable of carrying 10,000 troops at a trip. The *Justicia* was west bound under convoy and was not far out of sight of land when first torpedoed, at 3 p. m. on July 19. No serious damage was done but the engines were disabled, and the vessel was taken under tow to be returned to port for repairs. The convoying destroyers were unable to locate the submarine which had fired the torpedo. During her return trip to the Irish coast the vessel was repeatedly fired upon with torpedoes, six of which, after the first one, failed to find their mark, due to the quick work of the gun crews, who deflected the missiles or exploded them with shots from their guns. Shortly before noon on the 20th the eighth and ninth torpedoes struck the *Justicia,* which sank at about 1 p. m. Eleven men were killed in the engine room, all the rest of the crew and passengers being saved.

Despite the apparent success which these various occurrences lend to the U-boat warfare, the Chief of the German Admiralty Staff, Admiral von Holtzendorff, has admitted that the submarine campaign against the transportation of American troops must be considered a failure. He is quoted as saying that the numerous points of debarkation, coupled with the irregularity of the trips and the strength of the convoys makes it practically impossible for the submarines to sink the transports. On the other hand, he claims that the general campaign against shipping is proceeding satisfactorily. Opposed to the latter statement are the reiterated announcements by British and American naval authorities that the German submarine warfare is under control, and that the U-boats are being sunk faster than they can be built. It is admitted, however, that there is no ground for undue confidence that the danger is over—that unremitting effort in ship construction is still absolutely essential.

In the Mediterranean the Allied campaign against the submarines has met with even more striking results than in the main theater. It is not long since the waters of the eastern Mediterranean in particular were veritably infested with the undersea boats, and the sinkings reached enormous proportions. Now the sea is nearly cleared. A vast tonnage is passing thru it regularly, with very small losses.

A British submarine was attacked off the east coast of England on July 6 by five German seaplanes, which dropped bombs and directed machine gun fire at the boat. One officer and five men were killed. The submarine, slightly damaged, was towed back to her harbor.

On July 10 a German submarine stopped the Norwegian steamer *Hank* in the territorial waters of Norway, placed a prize crew aboard and started her for Germany. A Norwegian destroyer immediately went in pursuit of the steamer, which was quickly overtaken. The prize crew was forced to return to the submarine and the *Hank* was taken back to her home port. The Norwegian Government has made the incident the occasion of strong representations to Berlin. The recent repeated violation of Norway's territorial waters, together with the great numbers of her vessels that have been sunk, have greatly increased the anti-German feeling in the northern kingdom.

The United States armored cruiser *San Diego,* of 13,680 tons displacement, was sunk about ten miles off Fire Island Light, New York, on the morning of July 19. The cause of the sinking is not definitely known, but the commander of the vessel believes that she was torpedoed. Credence is lent to this belief by the reappearance of a German submarine at Cape Cod on the 21st, when the tug *Perth Amboy* and a tow of four barges were fired upon and destroyed within three miles of the shore. Two days later a fishing schooner was sunk off the Maine coast.

These attacks seem to indicate that the numerous sinkings along the American coast in late May and early June were not the result of a sporadic effort, but the beginning of a definite submarine warfare on this side of the Atlantic. If such be indeed the case, it has been of little effect since the first few days.

Submarine activities near the coast of the United States have been continuing steadily. Most of the vessels sunk have been small sailing craft and fishing smacks, but a few freighters have fallen victim to the U-boats. On the other hand it seems well established that at least two of the raiding submarines have been sunk, one by ramming and the other by gun fire from a British tanker. There is also a strong probability that a third one was accounted for by a depth bomb dropped by an American destroyer. Almost simultaneous attacks at widely separated points along the coast prove that there are a number of submarines operating on this side of the Atlantic.

The British ambulance transport *Warilda* was sunk off the coast of England on the night of Aug 3. At the time she was torpedoed the *Warilda* had on board 800 wounded soldiers. There were 123 casualties.

A British destroyer was sunk by a submarine in the Mediterranean on Aug 6, with the loss of seven of her crew. It was announced on the 13th that the French transport *Djemnah* had been sunk in these waters on the night of July 14, while carrying troops. There were 442 men reported missing.

During a reconnoitering expedition along the West Friesland coast of Holland on Aug 11 a British motor boat patrol was heavily attacked by enemy aircraft. Six of the motor boats failed to return. The British air forces which were accompanying the patrol brought down a German airplane north of Ameland. Another British air patrol witnessed the sinking of a German destroyer about eight miles northwest of Zeebrugge, apparently thru striking a mine.

Paris announced on Aug 17 that the old cruiser *Dupetit Thouars,* which was co-operating with the American navy in the protection of navigation on the Atlantic, had been sunk by a submarine. American destroyers rescued all but thirteen of the crew.

Spain has notified Germany that it is her intention to compensate herself for future sinkings of Spanish vessels by submarines by confiscating a corresponding amount of tonnage from the German shipping in Spanish ports. Over 20 per cent of the Spanish merchant marine has been torpedoed during the war, and more than 100 sailors have perished as a result. Germany is now notified that Spain can no longer submit to such actions. The note to Berlin reaffirms Spain's intention to preserve her neutrality, but states that no further reduction of the tonnage available for Spanish commerce can be permitted. There are about ninety German vessels in Spanish ports.

The U. S. transport *Mount Vernon,* formerly the *Kronprinzessin Cecile,* was torpedoed on Sept 5 about 200 miles off the French coast, while on the return trip after landing troops in France. She succeeded in getting back to port under her own steam. Thirty-five members of the crew were killed by the explosion. On the 6th the troopship *Persic,* carrying 2800 American soldiers, was torpedoed off the English coast. By skillful seamanship the troops were all transferred to the convoying destroyers without loss, and the vessel was then beached. It is thought that she can be salvaged. The submarine which fired the torpedo is believed to have been sunk.

A British destroyer was sunk on Sept 8 as the result of a collision during a fog. On the 12th an armed boarding steamship was torpedoed and sunk by a German submarine, with the loss of fifty-eight of the crew.

It has been officially announced that over 150 German submarines have been sunk since the beginning of the war. Several were accounted for in September.

On the night of Sept 26 the U. S. Coast Guard cutter *Tampa* was sunk in Bristol Channel off the English coast, probably by a German submarine. All of the 118 men on board are reported to have been lost.

The U. S. battleship *Minnesota* struck a mine off the Delaware breakwater early on the morning of Sept 29. No one was injured by the explosion, but a great hole was torn in the vessel's bow. Despite the serious injury, the *Minnesota* made port under her own steam and was promptly put in drydock. The mine is believed to have been placed by a German mine-laying submarine.

—General Notes on Operations, By Theaters

GENERAL

[The War—184th Week, Feb 7-13, 1918. By Raymond Lestonnat and Maj. de Civrieux. *L'Illustration,* Feb 11, '18. 2000 words.]

Military Operations

While awaiting for the great offensive announced by the official agencies of Germany, the hostilities continue to be limited to artillery actions and reciprocal *coups de main.* The most important of these have been carried out by the French in Lorraine, at the village of Alincourt, on the right bank of the Seille River; and in Champagne southwest of the Butte du Mesnil, where the French made a raid on a 1200 meter front and brought back more than 100 prisoners.

Likewise, on the British front, prolonged to the coast by the Belgian sector, which includes Nieuport, where there is a French detachment, the belligerents have engaged in the same sort of fighting—which is a prelude to the great offensive.

The German artillery has been particularly active around the east of Armentières and above all in the Cambrésis sector where the infantry skirmishes have made Quéant and Epehy assume a new importance.

The belligerents have put forth their most combative efforts in the air. During this period of watchful waiting the combat, reconnaissance, bombardment, and artillery observation planes have all been extremely active.

The French and English bombarding planes have visited all the important centers of offensive preparation behind the enemy lines.

Notably, on the 11th of February, 9000 kilos of explosives were dropped by our aviators on stations, depôts and cantonments of the enemy. The station of Metz-Sablons was partially burned up.

On the same day a British squadron executed a raid in Germany and dropped bombs on the city of Offenburg in the Grand Duchy of Baden. Offenburg

EUROPEAN WAR—Continued

is a railroad center from which upper Alsace is supplied. The German airplanes have been especially active behind the Belgian front.

On the Italian front, the Austrians executed violent bombardments followed by infantry thrusts on Feb 10, against Italian positions east and west of the Val de Frenzela.

On Monts Val Bella and Col di Rosso the Austrians' attempts to advance were promptly smothered by a precise artillery fire. On the slopes of Sasso-Rosso, that is, on the Italian right, a murderous artillery fire prevented the Austrians from entering advanced posts and observation posts which had been voluntarily abandoned by the Italians.

On the morning of the 11th the Austrian attempts were assuming an increased importance as evidenced by the masses of troops concentrated behind the Sasso Rosso. These concentrations were discovered and were so decimated by artillery fire that their attack never developed.

On the sea, the only incident of importance was the torpedoing of the Anchor Line ship, *Tuscania*, 14,348 tons, which was transporting American troops. The ship was attacked on the morning of Feb 5 off the coast of Ireland. It remained afloat long enough so that the boats could be launched and the greater part of its crew and passengers—about 2397 people—were saved. This has been the first American transport sunk by German submarines. The American transport service is extremely well organized.

In the political and diplomatic field the week was characterized by the signing of the first treaty of peace. This was signed at Brest-Litovsk by the representatives of the Ukranian Republic and the Teutonic Alliance.

[The War—185th Week, Feb 14, 1918. By Maj. de Civrieux and Raymond Lestonnat. *L'Illustration*, Feb 23, '18. 2500 words.]

French Front

In Champagne, between Tahure and the Butte-du-Mesnil, the Germans atempted to retake the ground lost by them on Feb 13. The German movement was in the form of a large *coup de main* on a front of 1200 meters at the German salient known as "La Courtine."

As a result of these operations a part of the German organizations fell into our hands, and on Feb 18, the Crown Prince's General Staff launched several attacks, by assault troops, against our lines near "La Courtine." These attacks were prepared by a lively artillery fire, but they were all thrown back.

On Feb 20 our detachments penetrated the German lines north of Bures and east of Moncel along a broad front, and to a great depth, bringing back more than 400 prisoners.

British Front

Artillery combats and *coups de main* have been exchanged during the week, particularly southwest of Cambrai, around Lens, and east of Ypres. The strongest infantry action took place at dawn on Feb 16, near La Vacquerie, west of L'Escaut. The occasion was a raid attempted by the Germans.

The belligerents, during this week, have been particularly active in the air. French and English planes have carried out continuous reconnaissance, and artillery observation. Bombardments have also been carried out. On Feb 17 six tons of bombs were dropped on the aviation fields near Tournai and Lille, on an important ammunition depôt near Courtrai, and on various cantonments.

On the 16th and 17th French squadrons dropped 29 tons of explosives on the railroad stations of Thiaucourt, Thionville, Metz-Sablon and the establishments of Hirson.

On Feb 18th-19th British planes carried out three bombing trips on the station and barracks of Trèves and Thionville.

Russian Front

Hostilities seem to have been resumed in Russia on Feb 18 at noon, when the Germans occupied the cities of Dvinsk and Loatsk without opposition. The inhabitants declared their absolute submission to the German rule, and the advance continues.

General Disposition of Enemy Forces

On the eve of the military operations of 1918, the enemy troops are approximately disposed as follows:

1. On the western front, about 195 divisions, amongst which there are probably some Austro-Hungarian elements in reserve.
2. On the Italian front, 42 Austrian divisions, already identified with about three German divisions in reserve.
3. On the Russian front (from the Baltic Sea to Pruth)—68 divisions of which 14 are Austrian—the latter are all on the Ukrainian front.
4. On the Rumanian front, 32½ divisions, 9 German, 20 Austrian, 2 Turkish, 1½ Bulgarian.
5. On the Balkan front, practically the entire Bulgarian army with a few German elements in support. Most of the German troops have been removed from Macedonia.
6. In Asia, 45 Turkish divisions supported by a few Germanic elements.

Naval Warfare

A flotilla of German destroyers coming from the Flemish coast, under command of Capt. Heinecke, executed a rapid raid as far as Pas de Calais on Feb 15, sinking eight small British patrol boats.

The southeast coast of England was bombarded by German aviators on the nights of Feb 16-17-18.

Some of the raiders ascended the Thames to the outskirts of London. The total casualties were 27 killed and 41 wounded.

[The War, 186th Week—Feb 21-27, 1918. By Maj. de Civrieux and Gabriel Lestonnat. *L'Illustration*, Mar 2, '18. 5000 words. 2 maps.]

French Front

The week was taken up by violent artillery bombardments. Our troops executed several successful *coups de main*. On Feb 22 French and American

troops effected a bold raid north of L'Ailette, bringing back 25 prisoners. On Feb 23 the region around Pont d'Aspach and northwest of Aspach-le-Bas was raided and all German positions destroyed or burned.

British Front

Reciprocal raids continue around Lens, east of Ypres, and in front of Armentières.

Thanks to favorable weather, the aerial activity has been intense during the past week on the French front. The bad weather has prevented such activity on the English front. On Feb 19 and 20, 26 high caliber bombs were dropped on the Thionville station by English aviators.

Russian Front

In spite of the complete submission of the Maximalist government, the Germans have continued a triple advance into Russia in the direction of the Gulf of Finland, Petrograd, and the Dnieper River. The German infantry columns are preceded at a great distance by rapid cavalry, light artillery, cyclists, and armed automobile elements.

After having crossed Mohn Sound, on the ice, and captured the port of Hapsal, one column moved against the fortress of Reval, which after a short resistance, surrendered on Feb 26. On the same day the forces of von Eichorn moved against Pernau and Dorpat.

The march from Dvinsk on Petrograd has been extremely rapid. In five days the German advance guards entered Pskov, 250 kilometers from the Dvina River, and half way to the Russian capital. As a result, practically all Livonia and Esthonia came under German control on Feb 25. There was some resistance around Pskov.

In the Vilna-Smolensk direction the Germans stopped at the Beresina River; Minsk and Borisov being successively occupied.

In Ukrania the troops of Linsingen have been thrust towards the Dnieper in two directions; the first to the north of Pripet, where there was a real battle; the second, on the different roads which join Kovel and Kiev. On Feb 26 the invaders had already passed thru Jitonin and were continuing their advance, without interruption towards the capital of Southern Russia from which they were less than 120 kilometers distant.

In Asia Minor, the Turks have re-entered Trebizond.

Palestine

General Allenby's Army, which was held back by the heavy rains, has renewed its advance to the northeast of Jerusalem.

On the morning of Feb 19 English troops attacked Ottoman positions along a front of 20 kms. All objectives were attained by nightfall.

The next day under a torrential rain they broke down the resistance of the Turks and pushed them back to six kilometers from Jericho.

At dawn on Feb 21 the Turkish left wing was seen to be retreating, so the Australian cavalry troops took up the pursuit, occupying the village of Jericho and pushing the Turks beyond to the River Jordan. Jericho is important as a supporting point for the English right wing in the depression of the Dead Sea.

In Mesopotamia English troops occupied Khan-Abu-Rayat 22 kms. from Ramadieh, and have moved up the Euphrates to the environs of Hit, which is 140 kms. from Bagdad.

[The World War. Events in October, 1917. By Maj. Guggisberg. *Schweiz. Monatschrift aller Waffen*, Nov, '17. 2200 words.]

The campaign of 1917 in Flanders began with the English attack of June 7 on the Messines-Wytschaete ridge. This was followed by an attack east and northeast of Ypres, July 31. The success of this attack was augmented Aug 16 in the direction of Langemark. Sept 20 the English attacked on the Ypres-Menin road. Sept 26 the front ran from Drei Grachten southeast to the vicinity of Langemark, thence south to near Gheluvelt, thence to Hollebeke where it joined the canal.

The English attack of Oct 4 was directed against the Broodseinde-Becelaere position and the Becelaere-Poelcapelle position. The English reached Reutel, Broodseine, and Poelcapelle, thereby occupying the east border of the Ypres heights. The next effort was necessarily to move forward the wings abreast of the center. This was tried on the left Oct 9. The English and French reached the southern border of the Houthulst wood. Oct 22 the English and French again attacked, the French right reaching Anthoine west of the Ypres-Staden railroad, the English left going east of the railroad. New attacks developed Oct 26 against Passchendaele and Gheluvelt. Oct 30 a mass attack, directed against Passchendaele, was made from Hollebeke to Houthulst wood. The west edge of Passchendaele was taken.

Oct 23 the French made an attack on the German salient northeast of Soissons on the Chemin des Dames. The 6th Army broke thru between Vauxaillon and la Royère. Oct 23 the French attacked the line Malmaison-la Royère unsuccessfully, but captured Allemant and Malmaison, and also Fort Chavignon and Vaudesson. Oct 25 the Germans withdrew from advanced positions at Pinon and Chevregny. The French occupied Pargny and Filain. This flanking of the Ailette Valley caused the withdrawal of the Germans from the Chemin des Dames between Froidmont and the heights east of Craonne, Nov 2.

The initiative in the west was, therefore, with the Allies. While the gains were local only, they believe them of such importance as to justify the hope of driving the Germans from French soil next spring. The energy characterizing the French attacks is remarkable.

The strategic defensive in the west enabled the Germans to carry out two offensives on other fronts. Oct 12 the Germans silenced the Russian batteries on the northwest coast of Oesel Island, and landed troops. Others were landed on Dago Island. Oct 16 Oesel was entirely captured. An attempt of the Russian fleet to break thru between the islands was foiled by a German fleet of 8 battleships, 12 cruisers, 40 torpedoboats and 30 mine sweepers. The Russians were driven from Dago and Moon Islands. Further operations were sus-

EUROPEAN WAR—Continued

pended at the opening of the offensive in Italy. Germany controls the Gulf of Riga. These operations may portend an offensive against Reval and Petrograd or against Finland.

It must be admitted that the German army command has always been able to find, on the front of several thousand kilometers, the precise spot where the Allies are vulnerable. If the Flitsch-Tolmein front, from which the Army of Below and the right wing of Boroevic's forces broke out Oct 24, be considered in its relation to the entire Isonzo front, it appears that it formed an obtuse angle with the Teuton line to the south of Tolmein. A successful advance therefrom would threaten the Italian communications on the Bainsizza plateau. The undertaking appeared impossible, however, as the Italians, on the east bank of the Isonzo, commanded Monte Nero, while on the right bank they had converted into a single fortress the mountain ridge parallel to and from 800 to 1000 meters above the river. If this ridge were taken the mountains would favor a march to the south and southwest, as the chain ran in the direction of the attack, and the cross ridge was cut by a gorge thru which ran a well-built road to Cividale. If the ridge along the Isonzo were taken, only a rear guard defense could be made on the parallel ridge. The German army command was evidently influenced by strategical rather than tactical considerations.

The attack commenced with artillery preparation which lasted four hours. Then the infantry moved forward, took the bridge-head of Tolmein at one blow, and reached the defile of Saga and the Kolovrat ridge. The Italians on Monte Nero withdrew across the Isonzo. During the following days the Teutons pressed forward, and on Oct 27 entered Cividale. Gorizia fell on the 28th. Meanwhile Austrian troops started an offensive north of Flitsch. The Italian army withdrew across the Tagliamento. Udine fell on the 30th. On the 31st the Teutons held the east bank of the Tagliamento from its mouth to Tolmelzzo. 200,000 prisoners and 1800 guns were captured.

[War Notes. By Capt. H. M. Johnstone, R.E. (retired). *United Service Mag.*, Apr, '18. 5500 words.]

We have been very skeptical of the predictions of a German offensive in February. Not only would Germany hesitate at putting everything into an effort whose chances of success are more than precarious, but surely she would not be likely to run the climatic risk of an early attack. A great attack is difficult in preparation and in execution. However well it may be going, there comes a time when guns and bayonets must be advanced to reap the full harvest of success. Under such circumstances, a break in the weather that prevents the movement of guns, that turns valleys into impassable morasses, and that fills the air with clouds and mists which prevent all observation, puts an end to the movement for the time being and enables the enemy to escape the consequences of defeat.

The Germans will hardly commit the error of an early attack. If the plan were to aim at complete and final victory in the western theater this summer, an early beginning might have certain advantages in their eyes, especially if they think the Americans can become formidable before next autumn. Neutral reports and the tone of the German papers indicate that they do not reckon America as a serious danger on land this year.

Everything leads to the belief that Germany will not hurry her attack. Some attacks must be made to sustain the spirits of the people, but they must not incur too heavy losses and thus endanger a prolonged resistance to any attack the Allies may make. We have reason to believe that many in the trenches are getting to dislike the idea of making attacks.

French critics and some neutral observers express doubts as to the certainty of a German attack. Towards the end of February, an important Copenhagen journal took the opinion of "international circles" in Denmark, and gained the impression that there would be no great German offensive on the western front, but that the Germans, sure of their ability to hold their present lines, would attack in totally different directions. That Germany has been making tremendous preparations in the west does not make it certain that she means to try for a clear decision in the field.

Italian opinion looks for an attack in Italy instead of on the western front, but opinion is by no means unanimous. Our opinion is that Germany will compel Austria to attack Italy in order to have the Austrian troops fully engaged elsewhere than in Russia and Rumania, and in order to keep the Italian army fully occupied and prevent the withdrawal of the French and British contingents from this theater. A third possible reason might exist if Germany does not intend an offensive in the west, but does intend to assume the aggressive against the Allied force at Salonica. Such an operation might entail very serious consequences for the Allies, but there are many points at which the Germans may well find the conditions too difficult for them. In any case, it would be a confession of weakness to attack in a secondary theater.

Activity of every kind increased on the western front in the week beginning Mar 10, indicating that the 1918 campaign might be about to open, but there was no sure sign of a German offensive on a grand scale. Colonel Feyler, in the *Journal de Genève*, has recently calculated that Germany has one million fewer men facing the Allies now than in 1914, due to having lost 2,500,000 dead, 500,000 prisoners, and 2,500,000 otherwise incapacitated.

The *Düsseldorf News* had an article in the first week in March by General von Ardenne in which the statement is made that "Germany's western forces will be greatly increased as a result of the peace with Russia," and the further opinion is expressed that the "struggle soon to break out will be decisive." The writer discusses, evidently with full knowledge, the outcome of the Versailles affair. A few words on this subject sufficed to ban several military articles in Great Britain for the month of March. The German writer says that the French and English believe now that salvation is to be found in a large army of maneuver standing behind the front ready to intervene in case of defeat, or to follow up any offensive success.

"One good Scottish observer at the front says, writing on the 11th March, that the 'heavy intermittent shelling of our front reveals increasing activity on the part of many German battery groups.' He speaks of this enemy work as 'curious bursts of fire on our front and support line trenches in a number of places, giving very fair imitation of a practice barrage without the subsequent appearance of infantry.' Is this firing done by artillery groups from the Eastern front, which would probably need some initiation into the more deadly systems of the west?" This activity extended from Houthulst Forest to below Armentières.

French and British officers have been doing something of the same kind in coaching the Italian artillery. Artillery methods are changing rapidly, and the change from 1914 to 1918 is almost comparable to that from muzzle to breech-looder.

The Italian army has recovered from its set-back of last year, and the frightful losses of guns and munitions have been more than made good. The army is stronger in numbers than last fall and the line is shorter. Moreover, the Allied air service has a notable ascendency on the Italian front. We are well prepared for anything Austria can bring to bear.

There are two chief directions in which the enemy may gain from present conditions in Russia. One is the release of troops for other theaters; the other the acquisition of foodstuffs and raw materials. The former is the more important, but it should not be exaggerated. In many quarters the inferiority of the quality of the units from the East is not duly allowed for. The Germans will be glad to get back some of the guns captured from them by the Russians, but the Ally guns that may fall into their hands thru Russia will require special ammunition which the Germans will hardly be in a position to manufacture.

WESTERN THEATER

See also
Bouresches, Capture of
Cambrai, Battle of
Charleroi, Battle of
Marne, Battle of the
Somme, Battle of the

[Impressions of a Visit to the German Front in Belgium. By Brig.-Gen. Luis de Santiago. *La Guerra y su Preparción,* Sept, '17. 7000 words.]

Open and Trench Warfare

Whether future wars will be won by open or trench warfare is still an undecided question.

In the present war, the diversity of nationalities, the great numbers of men engaged, and the enormous length of the battle lines, furnish arguments for belief in either method.

Open warfare was responsible for the German victories in Russia and Poland, especially north of the Nieman River; for the invasion of Belgium and its complete occupation in a few days, and for the destruction of the military power of Serbia and Rumania. In these campaigns the Germans greatly outnumbered their enemies, and the campaigns themselves were featured by the rapid movement of great numbers of cavalry, artillery of all calibers and infantry.

The war is between two entirely different types of people. The Germans, thoroly military, and whose organization had been well based and invariable for half a century, were trained to discipline and the development of warlike characteristics. Opposed to Germany is France, to whom the first days of war were a series of surprises, to wit the invasion of Belgium, the rapid mobilization of the German reserves and their complete equipment, the mobilization of the Ersatz and Landwher reserves, the appearance and masterly control of heavy long range artillery, and the new use of machine guns.

The tactical principles were not new, the advances into France and Russia were conducted according to the most accepted principles, by both Marwitz and Hindenburg. The only great difference that was noticeable in the early days of the war was the great number of combatants engaged.

The increase in food and ammunition expenditure complicated supply to such an extent that open warfare and movement on a large scale became impossible. The length of front over which any decided action took place had to be limited so that supply could keep pace with expenditure, and wastage, and in the case of large movements, so that transportation could keep up with an advance. Trench warfare was the inevitable result. And trench warfare will be a part of every modern war.

Maintenance of Morale and Instruction in the German Army

The following causes contribute to the vigor of the German army:

1. The existence in every social class of a great and virile patriotism based on the single idea of extending the Fatherland.
2. The belief that every individual should support the actions of the Government to his maximum ability.
3. The national pride, resulting from 50 years of military, commercial, and scientific achievements.
4. The character of the race itself, firm in its beliefs, steady in work, and educated in the traditions of military discipline and obedience to the laws.
5. The educational system, invariable, practical, and shorn of dangerous idealism.
6. Administration of justice, especially in the army where incompetence and bungling are promptly punished. Promotions and commissions are made very seldom and with great care. Many vacancies in the line are never filled. The staff officers are always chosen from among the best line officers.

The severe discipline is never relaxed. Drill for regiments not in the trenches, is held behind the lines every day. Recruit drill, squad and platoon drill are executed with the greatest exactness and attention to detail. Volley firing, by platoon and by section at the commands of the chiefs of section is given much attention.

Severity in instruction and exactness of execution in even the smallest details of drill technique, are, according to the Germans, the primary base of blind obedience.

EUROPEAN WAR—Continued

Every soldier feels that his officers are capable and that nothing is left to chance or luck. Every man has a blind faith in ultimate victory, which faith has been strengthened by the conquests to date. Unfavorable events such as the battle of the Marne are not looked upon as defeats, but as delays before an ultimate victory.

Idleness is avoided. Every man not on the firing line or in the trench system is kept busy behind the lines, bettering his own quarters, repairing roads, constructing telegraph or telephone lines, or cleaning and repairing material of all sorts.

The Spanish officers did not see a single playing card in any of the camps or cafés visited. Neither did they witness any case of useless labor. The General Staff officers are especially busy men.

Officers and soldiers always have their necessities cared for, efficient treatment is provided for the sick and wounded, families of soldiers are well cared for, and every effort is made to avoid taxing a soldier's physical ability.

New Things in Warfare

The most salient are:

Flexibility of organizations so that they can be adapted to the necessities of battle on any front or at any time.

Variations of organization. These are in the manner of grouping men, proportion of the different arms.

Constitution of divisions and army corps according to the nature of any particular operation or offensive. In the German army there is no feeling or prejudice between branches; everyone is a soldier.

There has been an increase of artillery and engineer troops with a corresponding increase in the services rendered by each. Before the war, divisions were composed of two brigades of infantry and one of artillery, the former consisting of 2 regiments of 3 or 4 battalions, and the latter of two six battery regiments of light artillery.

At present the two brigades of infantry have been consolidated into one brigade of 3 regiments, and in exchange the artillery has been increased by the addition of two or three groups of heavy field pieces, under the command of a colonel or a lieutenant-colonel. Batteries consist of 4 guns each. The separation of batteries into platoons and sections is avoided as much as possible, the entire battery being kept as closely together as the terrain will admit, and being fired by the battery commander. In battle the concerted action of artillery and infantry units is absolutely essential, and the Germans secure this liaison very well.

There are no principal and secondary arms in this war. All the elements and branches which constitute an army are essential to its existence and proper employment. In battle, the infantry and artillery bear the brunt of the fighting. The number of engineer troops is very great. As a matter of fact all arms are taught engineering and field fortification, but the special duties of engineer troops are numerous, and require for their execution a numerous and highly trained personnel such as the Germans possess.

Infantry has changed in organization, armament and method of fighting, but the foot soldiers of the German army are still commanded by infantry officers and non-commissioned officers. The principal arms of the foot soldier are hand grenades, bombs, explosives used in the shape of land mines, machine guns in large numbers, and special tools such as a short handled knife, sapper's and miner's equipment and wire-cutting devices. Infantrymen armed with the rifle, act as a guard for the special troops when these are performing their duties. The new specialties in dismounted warfare call for organization into smaller tactical units. Individual combat becomes impossible with the consequent abandonment of close order formations and the line of skirmishers.

Special organizations in the German army are called assault battalions. A special artillery is attached to each battalion. Assault battalions are drilled in tactics and combat procedure unlike that given the infantry. They drill extensively in grenade handling and throwing, in marching to the assault, when particular attention is paid to the maintenance of normal distances and to the maintenance of communications. First lines must keep in close and constant touch with special troops which support the advance, such as hand and rifle grenadiers and bombers on one hand and machine gun squads and special batteries on the other. Much time is devoted to signal drill and the transmission of messages and orders. As for the individual soldier, he is taught the manner of cutting wire and removing obstacles, such duties as will confront him when working alone or in a squad. The squad never exceeds 8 men. If given an isolated post or when working alone, every member of the squad has a few single things to perform.

Machine guns are usually in the trenches or grouped at defensive points. Those with troops are dragged by horses as no pack animals are used in the Imperial Army. New equipment has been developed and made uniform such as the steel helmet and the gas mask.

All small arms fire a pointed bullet. The artillery projectiles have the same shape with an enlarged ogive for greater range.

Aviation has received an immense increment. The manner of mounting machine guns in an airplane is as follows: two guns provided with a fixed mount are placed in the fore part of the fuselage, one on each sidde of the pilot, and a third is mounted in the center of the machine.

The fuselage is pointed at the target and the firing is done between the blades of the propellor, even when they are revolving at their greatest velocity. The rate of fire is regulated automatically.

All means of signalling and communication, even the most rudimentary, are made use of. One of the most used methods of signalling is by means of a pistol, firing star shells, or smoke bombs. To warn against gas attacks, the metal gong is used. Carrier pigeons are used very extensively. In some cases, submarines are equipped with carrier pigeons for carrying messages.

Motor transportation has not replaced that by ani-

mal entirely. All the field artillery and its ammunition columns are horse drawn. Altho motor transportation is an enormous auxiliary to the modern army, it has not entirely solved the problem of transportation. The numerous and expensive repairs, the lack of rubber, and indispensible parts prevent the draft horses from being entirely superseded. The motor transportation is used chiefly in the sanitary service. The commission did not see any tractors.

The use of asphyxiating and lacrimous gases has not been abandoned, so for this reason, the gas mask is always carried, even outside the zones of activity.

All the infantry is provided with a short handled digging tool, in the proportion of seven shovels and one pickaxe to every squad of 8 men. Certain men in each section carry a pick while others use the knife-bayonet.

Camouflage and cover are practiced almost to exaggeration in order to hide batteries, troops, and bomb-proof shelters. All means are used such as wooden guns, brush screens, cloth painted to imitate the terrain, and artificial trees. In order to decrease the visibility of trenches, the dirt is carried far behind the lines, and in some zones the defensive line consists of a multitude of very thick re-enforced concrete works. They are so well placed and so carefully camouflaged that at a distance of 100 meters they are invisible. The Flemish landscape favors this sort of defensive construction.

In the zone visited the German army seems to have taken root in the ground. None of the batteries of heavy artillery are mobile, and positions occupied by troops are permanent in construction and equipment.

Telephone communication is used for the control of all artillery fire. Some batteries are equipped with as many as 14 telephones. Illuminating shells and rockets are used extensively. The latter give a very powerful light.

No soldier carries any first aid appliances, except two sterilized compresses and bandages. The use of iodine for first aid treatment of wounds has been practically abandoned, having been replaced by serum innoculations. The anti-tetanic serum is extensively used, being administered to every wounded soldier at the earliest opportunity.

Impressions on the German Use of Artillery on the Belgian Front

The methods of German artillery fire on the defensive-offensive line of the western front are those of siege or coast artillery.

The minutest details of the terrain in the sector of fire are known, and fire is directed on points in perfectly defined zones. Fire correction consequently becomes a very simple matter, provided the ammunition does not vary, and the individual characteristic of each piece are known to the gunners. The following data is established for each piece, *viz.*: 1st, a day and a night aiming point. In the older type cannon these points are registered by fixed markers, and for the more modern guns they are established by orientation and the use of Goerz and Zeiss panoramic sights. 2nd, the sector of fire for every battery. 3rd, that part of the adjacent sectors which the battery may overlap in case of emergency. 4th, general maps of the entire terrain, and detailed maps of the battery-sector. 5th, signal cards. The majority of batteries are practically casemated. Each battery group has a large dug-out for its central telephone station. These underground central stations resemble a city central in extent and equipment. Ground observation is carried on from numerous advanced observation posts located in trees, towers, ruins or sap-heads. Other observation posts are behind the lines but all are connected with their batteries by telephone.

In the battle of the Somme the German artillery did not have the proper aerial assistance. To-day this fault has been remedied. The Spanish Commission saw great numbers of horses on the Belgian front. These were mostly Belgian, Russian, and Rumanian draft animals which had been captured and were used for transportation purposes. Stock receives very careful attention at the hands of the Germans. The horses are as well cared for as the men themselves.

Cannon of 15 and 21 centimeters captured from the Russians were also in use. The Germans use every piece of serviceable artillery captured from the enemy. The resultant variety of styles and calibers is very great but there seems to be no difficulty or confusion in ammunition supply.

Organization of General Staffs—Commissions

Division general staffs consist of from 10 to 15 officers, among whom there is a first chief of the general staff; ordinarily a major or a captain. Members of general staffs are always active, intelligent young men who are thoroly familiar with their duties and are full of enthusiasm. There are two or more officers in every staff who concern themselves with artillery only. One of these is known as the "gas officer" who is in charge of asphyxiating and lacrimous gases, gas masks, employment of gases in attacks, gas supply, and all data concerning gases.

General staffs of army corps are larger than divisional staffs, and lastly the staffs of field armies and groups of field armies are so large that they are organized in sections. In some cases an army staff may number several hundred officers.

Each staff has everything necessary to the full execution of its duties. Ample transportation is provided. One or more headquarters companies, clerks, assistants and extensive supplies are always on hand. The object is to prevent staff officers from being distracted by anything but their duties.

Certain platoons are organized solely for the purpose of going over the battlefields and collecting abandoned and lost equipment of all sorts. These articles are collected and sent back to the supply depots, where they are repaired or made over and forwarded to the front for use, or else stored in the general supply depots.

The general staffs are brought together every day at the mess hours where one of their members presides as at a formal mess.

Efficacy and Future Employment of Cavalry

The cavalry of the German army has played an im-

EUROPEAN WAR—Continued

portant part in the war. German officers do not believe that it has lost its importance, on the contrary, their conversation is full of many great achievements which would have been impossible without the cavalry.

The invasion of Russia by seven cavalry divisions, one of them consisting of 10 regiments under a single division commander, the brilliant work of Marwitz's cavalry in Belgium and France, the rapid conquest of Rumania, and many other successes, demonstrate the importance of maintaining a large proportion of well equipped and trained cavalry. Cavalry can not be used in trench warfare.

The Germans believe that there is a great future ahead of the cavalry when the power of the Allies has been broken down.

An audacious cavalry, assisted by a large proportion of very mobile, quick-firing artillery and a few battalions of infantry can destroy a retreating army in a short time, without giving it time to reorganize.

[Hurtebise. By Maj. T. E. Compton. *United Service Mag.*, Nov, '17. 4300 words. 1 map.]

(A description is given of the terrain north and west of Craonne in the vicinity of Hurtebise farm, which for months figured so prominently in the French communiqués concerning operations in the Chemin des Dames sector. There is an account of the action at Hurtebise on Mar 7, 1814, when the troops of Marshal Ney captured the farm from the army of Blucher, under the eyes of Napoleon. The writer then describes the operations in the vicinity beginning with the capture of the farm by the French on Apr 16, 1917, one hundred years later.)

[Crisis of the War and the Advent of America. By Hilaire Belloc. *Land and Water,* Dec 13, '17. 3600 words.]

The two great factors of the war in its present phase are revolutionary in their character and novelty. They are the elimination of the Eastern front on the one hand and the junction of the United States with the Allies of Western Europe on the other.

The elimination of the Eastern front, thru the Russian Revolution, gives Prussia and her dependents an active superiority over western civilization, that is, France, Great Britain and Italy. It gives the enemy a superiority in men and material. The war ceases to be a siege, and becomes a duel. Our eastern ally has failed us altogether.

To such a situation there comes in the promised help of the United States. The first appearance of American units, naval and military, correspond with the summer collapse of the last Russian effort. This autumn and winter—which have seen the tremendous blow against Italy, and the enemy concentration in front of Cambrai—have also seen the new American force in training upon European soil for the new tasks of trench warfare, and its rapid and continual increase.

Upon that battle line which, interrupted only by the neutrality of the Swiss Mountains, stretches from the Adriatic to the North Sea, civilization is now upon the defensive so far as Europe is concerned. The United States have come in as a last reserve.

The Central Empires now thus massed against the West have the numerical advantage in men and material. They also have advantage in communications.

(1) Their communications are wholly by land, and therefore rapid and simple, while those of the Western Powers are largely by sea, and therefore slow and complex, involving a few congested points and at least two transshipments.

(2) They are working within an arc of a circle, and the Western Powers are working outside the arc of that circle. Therefore, even if the communications of both were entirely by land, the advantage in rapidity and concentration would be with the Central Powers.

(3) Their communications, being by land and within their lines, are invulnerable. Much of our communications being maritime, are highly vulnerable and subject to an increasing strain.

(4) Their supply of material, especially of coal and iron, is nearly central to their effort; their three great centers of production, Westphalia, Silesia, and Bohemia—to which may still be added the Belgian field—are secure from interruption. The center of production of the Western Allies on the other hand is, so far as coal is concerned, almost entirely placed in this island, to which much of the iron ore must be imported, and from which supplies must go out to the other Allies, both under the modern risks of maritime communications.

(5) The Western Allies are dependent upon maritime communications for mere subsistence. Coal, for warming and transit, must come from Britain; most of her food and raw material must be got into Britain from beyond the sea.

(6) The Central Powers have the advantage that they are all the appanage of Prussia, whereas their opponents are a coalition of equals. Hence the complete unity of command with them, the impossibility of realizing it with ourselves.

Such are the elements in favor of the enemy. That they should be everywhere appreciated is essential to our future conduct of the war.

Enemy Handicaps

Now let us look at the other side. The enemy is blockaded so far as goods from over sea are concerned. He lacks lubricants for his machinery, fats for his food, and such material as India rubber and such articles of ordinary consumption as tea, coffee, rice and cotton. He is very short of everything. He lacks wool. He is rationed far more strictly, and suffers in daily life far more heavily than his opponents. The statistics of sickness and death among his civilian population are causing him grave anxiety.

His losses in men have been heavier than those of any of the Allies except the French, and even the French losses are not quite as heavy in proportion as his own. Lastly the enemy has the worst before him in that the chances of the near future mean for him not an alternative between victory and a difficult de-

fensive—as they do with us—but an alternative between victory and complete disaster.

The great factor remaining in our favor is the advent of America with her vast reserves of men, money, and material. The limitations of so formidable an asset upon our side are almost entirely contained in the one word "communications."

The limitations of an American force to be maintained in Western Europe upon the present line of fighting proceed from three things:

(1) That all the supply whatsoever, must come from the home base. Not only strictly military supply, but food and indeed everything.

(2) That the main communications are maritime.

(3) That both the main communications and the last stages by land are each of great length. The former vary by two and a half and three thousand miles, the latter between two hundred and three hundred miles. Calculating by rough rule of thumb, every man maintained by the United States upon French soil requires in gross tonnage some six tons of shipping to maintain him. Further, of two men thus supported upon the European side, we must not count upon more than one being present in an organized fighting unit upon the immediate front. These two rules of thumb show at once how severe are the limitations imposed.

The factors of the power of replacement and the vast material resources of the United States must be included as being greatly to the advantage of the Allies. In conclusion the exceedingly important element of blockade must not be forgotten. The moment that the neutrality of the United States ceased, the nature of the blockade went thru a revolution in our favor. It became as nearly as possible absolute, and what every member of our Administration had desired it to be from the beginning.

The main points for and against us are thus summarized in this very critical moment when the enemy has found so much new strength thru the anarchy in Russia, and when the Allies are waiting the development of American aid.

[Chinamen in France. By Charles Watney. *Land and Water,* Nov 22, '17. 1700 words.]

Innumerable races and nationalities are found behind the lines in France employed on purely labor duties.

By far the most numerous are the Chinese. By the end of the year there may be about 100,000 of them in France. They make excellent laborers, are good travellers and appear hardy and well satisfied with their lot. The rate of pay is good. In addition to free clothes, free food and free accommodation and medical attendance, each man receives a franc a day, while an allowance of ten Mexican dollars a month is paid to his family at home.

It would not be surprising to learn that the work is equally popular in China among the families whose men are thus at the front. The one franc a day is only the minimum rate paid to unskilled men. Those who have any special trade aptitude can earn a great deal more. The French were the pioneers in employing Chinese for labor duties in rear of the fighting lines. The men are enrolled with the acquiescence of the Chinese Government in Northern China.

[The Offensive of the Entente. By Gen. Von Ludendorf. *La Guerra y su Preparación,* June, '17. 2000 words.]

(A summary of events on the western front in the first part of 1917, from the Germain viewpoint.)

Originally, the intention of the Allies this year (1917) was to break the German lines along an ample front, from near Arras to the environs of Rheims. This attack was prepared by several months of work. The object of the attack was frustrated when the German line retreated between Arras and the Aisne, about the middle of March.

The Entente now faced a new situation. It could choose between preparing another attack on the same sector or attacking a different sector of the line which had not moved. In view of the increasing effectiveness of the submarine it was forced to the latter decision. The submarine warfare forced the Allies to attempt a quick decision as evidenced by the British attempts to break thru our lines around Arras, and by the French activities on the Aisne and in Champagne.

The British artillery fire along the Aisne-Arras front had increased on various occasions during the month of March, 1917. On Apr 2 the British opened their artillery preparatory fire for the projected battle. At dawn, Apr 9, 13 British divisions attacked along the line Givenchy-Neuville-Vitasse. The English penetrated the German lines on both sides of the Scarpe to a depth of 4 or 5 kilometers. The Canadians also captured Vimy Ridge. These preliminary successes were due to the fact that our artillery was very slow in replying to the British, and our firing was on too modest a scale.

The advantages which the British gained on the 9th and 10th of April caused the German staff to move the line back on the night of Apr. 11-12 to a new position which approximated the Lens-Arleux-Roeux-Monchy line and thru which the British have been unable to pass. On the 6th of April a terrific artillery fire had been opened on the Aisne, between Vailly and Bétheny and in western Champagne, between Pruny and Auberives. This indicated an immediate French attack between these points. The German artillery immediately opened a highly destructive fire. The French infantry attack which had been scheduled for the 13th was postponed until the 15th and later to the 16th of April. On that day the French, in compact masses, launched the attack along the Soupir-Bétheny front. The French objectives were very extensive as we have learned from captured orders, and judging from the point of view of the French authorities.

The battles of the Somme had shown that the 1916 system of attack was not conducive to a strategic rupture of the enemy lines. The Allies then determined to break the line step-by-step, allowing the infantry to advance only over such ground as had been

EUROPEAN WAR—Continued

subjected to an artillery preparation. This method always allows the defense to bring up new reserves, and to move into prepared positions. For this reason the Allies had thought to break thru in their first spring offensives.

Nivelle's plan consisted in breaking the German line on the Aisne on Apr 16, 1917. On that day the Thirty-third Army Corps was to advance to the region of Brienne, that is to say, to a depth of 12 kilometers behind the German front.

The Thirty-seventh Division was under orders to advance from Cormicy towards the northeast to the Merlet-Orainville line, then to oblique to the east and continue along the Suippes River to Aumeunaucourt-le-Petit, while the Fourteenth French Division was to capture Brimont. The strategic plan consisted in throwing the Germans out of the South Aisne district by violent attacks delivered in an easterly direction, so that the German forces would run into the French divisions which were advancing from Moronvilliers and Auberives on the 17th of April. No attack was projected on the 20 km. front between Bétheny and Prunay, east of Rheims. This sector was to be cut off on the 16th and 17th by the easterly advance from Brimont and the northerly advance from Auberives.

This movement south of the Aisne was in conjunction with another projected French advance north of the river along the Braye-Cerny-Craonne line, where the Twentieth French Army Corps was to penetrate 12 kilometers of the undulating wooded country southeast of Laon and fall on our New Sigfried line from the rear. On the 16th of April the Twentieth French Corps' objective was the Ourcelle-Lierval line. Once the line was broken along its 80 km. front the French Army of Pursuit, consisting of 17 especially trained divisions, was to rush thru the breach and take the strategic objectives Rethel and Laen.

Nivelle's plan was ambitious and was very well conceived. It broke down before the resisting power of the German troops. The 28 divisions, which attacked on the 16th and 17th of April, only gained local advantages at Braye, and to the west of this point they penetrated the German lines to a depth of about 3 kilometers. For this reason the part of the German front which formed a salient towards Condé was withdrawn a few kilometers to the north a few days later. The French also gained some ground north of the Aisne around Juvincourt. On Apr 17 the French advanced in Champagne around Moronvilliers but were thrown back by counterattacks and the heights around this place have remained in German hands. The successes of the 16th and 17th were extremely costly for the French and the sacrifices made were out of all proportion with the success gained.

The Entente's offensive lost much of its force because it was not a concerted effort of the French and English. The reasons for this offensive were purely political. The events in Russia had made it absolutely necessary that the Entente gain a big military success. But France was not prepared for an offensive at the beginning of April.

At Arras, the big attack of the 9th was followed only by partial attacks in the following few days. These were especially violent on both sides of the Scarpe. The second grand assault on the Lens-Bullecourt line took place on the 23rd of April. The front of attack was 30 kilometers long. On the 23rd and 24th the English only succeeded in capturing the ruins of Guemappe and Gavrelles in spite of the continuous introduction of fresh fighting troops into the lines. Along the rest of the line the enemy was everywhere driven back by our counterattacks. The German infantry, which garrisoned the sectors attacked, was almost always able to throw back the attack without having to call up the reserves, which were well disposed to the rear.

The interval between the first and second battles of Arras was 14 days; the attacks now followed each other in rapid succession, due to the fact that the artillery had no success whatever, and consequently had no reasons for advancing. The third grand attack was on the 28th of April, when Canadian troops captured Arleux, and on the 3rd of May, when they took Fresnoy. The Germans recaptured Fresnoy on May 8.

On May 11 and 12 local attacks were launched on both sides of the Scarpe and on Bullecourt, these attacks were repulsed, the English occupied Bullecourt and Roeux for a short while.

On the French front there was no large attack until Apr 30 when an assault was launched on an eleven kilometer front south of Moronvilliers. Partial attacks were incessantly being launched around Cerny, Hurtebise, and Craonne and between the Aisne and Brimont, where the French would take German positions from which a flanking artillery fire had been directed against the old French positions in rear.

On May 4 the French artillery fire reached its maximum intensity and local attacks were launched between the Aisne and Brimont and south of Moronvilliers without success. At dawn on May 5 15 French divisions attacked on the 35-mile front between Vauxhallon and Craonne after their artillery fire had reduced the German positions absolutely. The French captured the German positions along the Chemin des Dames, but the German counterattacks put most of these positions back into our hands.

Neither the English nor the French succeeded in their plans which were to break the German line. After having failed in their first great attacks of Apr 9 and Apr 16 and 17, they could not expect to succeed.

From a captured document from the Seventeenth English Army Corps we learn that in the attack of Apr 9 on the Maison Blanche sector they had 456 field guns, 240 heavy guns, from 15.2 cms. to 30.5 cms. in caliber, and 268 bombthrowers, on a front of 5 kms.

In the first week of the battle of Arras the British used up twice as much munitions as in the first week of the battle of the Somme. In the latter battle some 200,000 soldiers occupied a front of 40 kms., while in the former the front was more than 100 kms.

The new German defensive tactics are not based on holding rigidly to the ground. They allow great flexibility in this respect. The idea has been to save our own man power and use up the enemy's. And

if this entails the loss of a few acres of ground, the loss is well worth while.

The German defense prevented the Allies from gaining their strategic objectives.

[Campaign in France—Situation on Dec 1, 1917. By "A." *Memorial de Caballería,* Dec, '17. 2500 words.]

After four months of bloody fighting the British finally captured Passchendaele Ridge. The occupation of this place by the British placed them in position to debouch on the plains and threaten the Belgian coast with its important submarine bases. It was expected that the final capture of Passchendaele Ridge would result in the German evacuation of the Belgian coast.

But the capture of this prominence merely marked the end of the bloody battle of Flanders. It is a question whether this English victory was worth all the lives and the gigantic amount of munitions that the British sacrificed. Looked at purely from a tactical standpoint Passchendaele is simply one of the infinite number of Flemish hills situated at the crest of a low chain of ridges, and slightly commanding the country to the east. Aside from this, Passchendaele is important because it is a good point of sortie into the plains beyond. But as long as this movement is not executed Passchendaele signifies nothing. More than a month has elapsed since the final actions around this point and the Germans have had ample time to move up their artillery, reorganize their lines and re-group their reserves so as to meet any contingency which may arise.

In conclusion, the English Army was not in condition to carry out the contemplated strategic maneuver, that is, the debouch into the plain, and in spite of their mighty efforts and recognized bravery, they have not turned the balance of war in their favor.

The battle of Flanders is a conclusive example of the so-called war of attrition, in which the attacker is always the greatest loser.

In spite of the loss of French divisions, which were sent into Italy, and the consequent extension of the English front, which put an end to the Flanders battles, on Nov 20, Field Marshal Haig undertook a violent offensive on the Cambrai front—between the Cambrai-Bapaume, and Cambrai-Péronne roads.

It was a British practice not to launch the smallest offensive without a thoro bombardment, which practically destroyed the German front line trenches and their garrisons before the British infantry started their advance. The Germans blocked this form of attack by the use of machine gun blockhouses, by trenches on the reverse sides of hills, by cutting down the size of the front trench garrisons and by good location and opportune employment of their reserves. This was also the traditional way in which all Austro-German attacks were launched.

Breaking away from all precedents the Austro-Germans perforated the Italian front on the Isonzo after an artillery fire of 70 minutes only. Field Marshal Haig did not forget this German attack, and made use of the same system in his Cambrai thrust. Great numbers of tanks were cleverly concentrated behind the British lines and the assault columns were given a large proportion of machine guns and hand grenades. Various cavalry regiments were also brought up behind the front lines. The entire British preparation was carried out without any knowledge of it reaching the Germans.

On the morning of Nov 20 the Third British Field Army advanced behind the tank sections on a front of 15 kms. between Moeuvres and Honnecourt. It was one of the most complete surprises in the history of warfare. The first German line fell without any resistance, the second was easily taken; the British cavalry burst in on the flanks and played havoc amongst the reserves who did not know what had happened. The success was continued; Marcoing fell on the 21st, the Scheldt Canal was crossed and Masnières, 5 kms. from Cambrai was captured. The maximum penetration was 8 kilometers. 9500 prisoners and 100 guns were taken.

Tho Cambrai was menaced, the wings of the new British salient were insecure. If Field Marshal Haig had maintained active battle all along the front lines, so as to entrench himself properly, it would have been a complete and brilliant victory. But Field Marshal Haig decided to continue the battle at a redoubled energy.

On Nov 23 the battle was again taken up. This was a tactical mistake, due in a great part to the lack of practice among the English commanders in open warfare. The battle had not progressed to the extent where strategy entered into it. It was soon found that the advanced position—near Cambrai—was too narrow to accommodate a sufficient number of guns and to allow the free movement of troops and supplies. There were two remedies available—an audacious stroke could be made at Cambrai alone, or the flanks could be widened out by reducing the German strong points at Honnecourt and Moeuvres. The latter procedure was the simpler, was more sure of success, and would have cost the least number of lives. The former would have succeeded against an unsteady enemy. Haig decided to strike at Cambrai. Knowing the Bourlon Wood dominated all the country west and northwest of Cambrai, he directed an attack on the town of Bourlon, near the wood of that name, and a second attack against Fontaine, which fell into his hands. But this move exposed his left flank which was badly supported between Bourlon and Inchy, and he exposed his troops which were furthest advanced, around Fontaine, to a double envelopment. In order to distract the German attention from these important points Haig made two offensive demonstrations—one at Bullecourt to the north, and the other at Vendhuile to the south. After the 23rd the German reserves were already on the battlefield.

The German Commander, General von Marwitz, did not pay very much attention to the advance on Cambrai—his main attention was centered on the long weak English flanks and he massed his reserves so as to strike at these flanks. The British advance continued, Bourlon fell on the 25th and Field Marshal Haig declared it to be a decisive victory. Von Marwitz continued his preparations. From the 24th to the 29th

EUROPEAN WAR—Continued

the fight was centered around Bourlon, which changed hands many times.

On Nov 30 the powerful German counterattacks began. Bourlon and Fontaine were retaken, Bourlon Wood was cleared of the English and the entire British left wing had to retreat. The right wing was even harder pressed. On Dec 1 the Germans retook Vacquerie, and broke the old line south of Gonnelieu, which was captured with Villers-Guislain. Both wings being driven in the front withdrew automatically. Masnières had to be evacuated and the British fell back on Marcoing. Such was the situation on Dec 1. In three days Haig lost one-third of the ground he had taken, 5000 prisoners and 60 guns.

The Cambrai battle was not the great victory which was claimed by the British in the first days of its development. The force of the German resistance and counterattacks was more than had been expected. To make it a great victory reinforcements from the Flanders front would have had to be moved up. But this would have interfered with the only strategic objective which the English have kept from the beginning of the war, namely, the control of the Belgian coast.

[The World War. The Military Situation in June, 1917. By Maj. Guggisberg. *Schweiz. Monatschrift aller Waffen*, July, '17. 1250 words.]

June, 1917, was a month of preparation. The only great operations occurred on the West front where the English attacked at Lysbogen and Lens. In the former case the terrain was well chosen. The English attacked a salient between Wytschaete and Messines, hoping to surround the Germans between the Lys and the Ypres canal and to thus break thru. The front at this place had resulted from the operations in 1914 and from the two German offensives at Ypres. At the beginning of the first fight at Ypres the line south and east of that place had been held by the Fourth English Corps, supported by the Cavalry Corps. Oct 24, 1914, these troops were reinforced by the first and by a brigade of the Lahore Division. About Oct 30 the Germans launched a strong attack in the direction Menin-Ypres, and took Hollebeke, Zandvoorde and Messines. At this time the French under Foch (parts of the Ninth Corps and the Thirty-second Division, and the Ninth Cavalry Division) supported the English, but were unable to move forward. Wytschaete and Messines remained as two German advanced positions, flanked by the Wood of Ploegsteert. On June 7, 1917, after seven days' artillery preparation, the English exploded 19 mines under the German positions. The infantry moved forward under an accurate barrage. The attack was commanded by General Plummer. The Germans withdrew to the bend in the Ypres Canal, north of Hollebeke—two kilometers west of Warneton. This advantage was not followed up by further attacks.

A similar attack was made on Lens. On June 28 artillery fire and patrol attacks began. On the 29th the English covered the German front from Hulluch to Gavrelle with drum fire; at 8 p. m. moved on Lens, the main column attacking on both sides of the Souchez Brook, and flank columns attacking north and south of Lens. They took Avion and some trenches between the west edge of the Park of Oppy and the Windmill of Gavrelle. The advance does not alter the situation. Lens lies in a hollow between hills which command it. Of these, Hill 70, on the Lens-Hulluch road, and Hill 72, north of Mericourt, are in German hands. It will be useless to take the town before these hills are taken, and the latter undertaking will be difficult.

On June 30 Kerensky commenced an attack in East Galicia on the army of Bothmer southeast of Lemberg.

The arrival of American troops for the salvation of European freedom is an event of historical importance.

[The Characteristics of the Belgian Front. - By Maj. Willy Breton, Belgian Army. *Revue Militaire Suisse*, Nov and Dec, '17. 12,200 words. Illustrations. Maps.]

The Effort Made by the Belgian Army Since the Battle of the Yser

It is impossible to overlook the great trials to which the Belgian Army submitted in the beginning of the campaign. Surprised by the war in the middle of a period of reorganization, she struggled alone, for many long weeks, against forces numerically and materially superior.

The Belgians resisted at Liége, beginning on the 4th of August, several German corps. On the 12th these troops were victorious at Haelon, and it was only on the 18th, in order not to be overwhelmed by the invaders, that the army abandoned its positions on the Gette and moved toward Anvers, a national stronghold, where all the mobile forces must be concentrated. Namur fell on the 23d, 12,000 men escaping to Anvers. Here the whole army continued the struggle. It tried to help the common cause of the Allies by a sortie executed at the time of the Battle of the Sambre, and by another, particularly opportune and vigorous, coinciding with the Marne.

On the 2d of September the first great shell fell into Antwerp. After standing an unheard of fire the general order for retreat was given on the night of the 6th of October. Only one passage was clear, between the Escaut on one side and the Holland frontier and the sea on the other. Protected by two cavalry divisions as rear guard the miracle of gaining the Yser without having abandoned anything to the enemy was performed.

The line of the Yser had not been arbitrarily chosen. But in the circumstances it was the nearest possible position which the Belgians could hope to unite with that of the allied forces in the north. The first act was the desperate struggle of 8000 men with 350 guns, later aided by 6000 French Marines, against 150,000 Germans with 500 pieces of all calibers, during the last half of October. Galvanized by the action of its king the army held on for eight days until the French division of Gossette came. On the 31st the Germans were chased from Ramscapelle and obliged to flee from the inundation, which little by little, invaded the low plain between the river (Yser) and the

railroad extending from Nieuport to Dixmude. From this time the Battle of the Yser was virtually terminated. The direct route toward Dunkerque and Calais was barred to the enemy.

Matériel was now in a bad state and the infantry was reduced to 32,000 rifles but they continued to guard the little bit of the country still remaining. Circumstances have not permitted the Belgian Army to attempt operations of any great extent. Outside of the check to the Germans at Steenstraet (April, 1915) where asphyxiating gases were used for the first time, her only activity has been to improve her positions.

General Conditions of the Region to Be Organized

The Germans tried to get to Calais again by violent attacks in the region of Ypres, and on the 10th of November, 1914, they succeeded in driving the French and Belgian troops across the Yser at this point to the left bank, giving up Dixmude. With the approach of winter the battle died down on the whole Flanders front and the two belligerents began to renew their forces and to organize their respective positions. The enemy kept up a continuous artillery fire crumbling into dust the simple, straggling shelters of the front on the Yser.

In this ruined region, in mid-winter, the Belgians set to work to change their fragile barrier to a solid rampart. The front confided to the army began at the ancient fort of Knocke at the junction of the Yser and the Yperlée. Avoiding Nieuport by the east it rejoined the railroad which led to Dixmude, separated from the Yser by the flood. To the southeast of Oud-Stuyvekenskerke the line curved in to join the river at the sixteen-mile mark, then ran along the left bank to the sea, bordering on land, which the flood gradually going south, had turned into swamps. This front was enlarged, with the building up of the army, along the Yperlée and canal of Ypres as far as Boesinghe, a total distance of at least 31 kilometers.

It is true the flood covered a great part of the line, but freezing weather could render this useless, and besides, to regulate the inundation was a stupendous task in itself. The blanket of water was not an impassable barrier. Even in the place where it offered the most security—between the railroad and the Yser—the roads, which formed banks at all times, the simple swellings of the ground at the approaches to villages, emerged in the vast lagoon to offer possibilities of passage, or constituted isles favorable to occupation. From the first the possession of these places was disputed, each side desiring to cover his main positions by advanced posts.

In the south the flood had missed the region of Dixmude, where the ground rises slowly. There the two adversaries were face to face, separated only by the 15 to 20 meters of the Yser. Then it was necessary to create around Nieuport, where the locks were, a bridge head strong enough to stand against any test. So must an untakeable bastion be erected before Dixmude as this was a vital point in the line. Thus, where the principal positions of the enemies were not in close proximity, the advanced posts were.

The defensive organization that the army had created had a double end:

1st. To secure the solidity of the left flank of the allied forces and bar the northern roads to Dunkerque and Calais.

2d. To conserve to the Belgian nation, for both political and military reasons, the last scrap of the nation.

Due to the artillery, one position alone was not enough, a deep zone had to be formed, and several successive positions created in it. This is the only means of localizing a momentary success of the enemy which he may have at any time if he is willing to pay the price. Each position must be composed itself of a series of lines of defense, traced a short distance from each other, and each preceded by defense accessories. Construction was rendered difficult by the uniform nature of the ground, as on the Belgian front it is impossible to hide *in* the ground, which scarcely rises above the level of the sea. The positions nearest the enemy are continuous. Each line presents a snakelike appearance, salients and re-entrants occurring all along the line. The positions encircle farms and little woods, which are transformed into works. When the former are lacking it is necessary to construct artificial works of sand bags, the dirt being carried from the rear at night by soldiers. This work was very difficult under the star shells of the Germans and over the slippery, miry roads. The entire zone had to be sown with emplacements for batteries of all calibers at various distances from the enemy. Irrigating ditches covering the country checker-board fashion made construction harder because of the multitude of slat-work ways, which had to be built across them.

Lines of communication also were rare, either railroads or high roads. The small local roads were too muddy to be of much use. This whole country was under observation of the enemy on favorable places east of the Yser; in the north from the dunes of Westende; in the center from the region of Keyem; in the south from the heights of Clerkem. So not a movement of the Belgians passed unobserved until clever artificial masks were constructed.

General View of the Work Accomplished

The trenches of the Belgian front, unlike those of the rest of the western front are ramparts *raised above the soil* and not dug into it. This is due to the swampy ground. Millions of sacks of earth had to be brought from the rear.

At first, the inundation could not be regulated so as to be a nuisance to the enemy only. But being in control of the locks at Nieuport the Belgians held the key to the flood. Because of the fire of the Germans, which threatened the locks, multiple dams had to be erected and dikes often over a kilometer in length. The dams are of two types: Fixed ones and shutter-like ones, which may be opened at will. The latter are used to regulate the flow.

The trenches had to be constructed in ten to fifteen lines, for the total length of the front. At the rate of seven or eight cubic meters of earth dug for a linear

EUROPEAN WAR—Continued

meter of trench, including traverses and parados, and then a minimum of four cubic meters carried up, the trenches on the front were composed of three million and a half cubic meters of earthwork. Part is in sacks entirely, part is revetted with bags, and part revetted with bricks, all brought from the rear.

In general, all field works have been constructed by the infantry either in whole or in part. On coming out of the trenches they take up the pick and shovel and drop the rifle.

Special works, for use by special troops, are constructed by special units organized for the purpose (sappers, miners, pontoniers, telegraphers, road workers, and labor battalions). These are all auxiliary engineer troops. Heavy and field artillery batteries build their own emplacements.

Covers, Redoubts, Concrete Combat Posts

Sand bag construction has been found unsuitable as it is blown in every direction by artillery fire. A multiplicity of concrete works have been constructed in close proximity to the enemy; these include bombardment shelters, machine gun shelters, combat posts for battalion, regimental and battery groups headquarters. Important points in the line itself have been converted into concrete forts. In all, between 350 and 400 thousand cubic meters of cement have been used for this work.

Lines of Communication

The few lines of communication in Flanders were rendered useless by the October-November, 1914, battles, and it has been necessary to construct 180 kms. of standard gauge railroad and several hundred kms. of Decauville lines, the latter leading up to the first line trenches.

In order to pass the thousands of streams, ditches and canals, besides the miles of inundated country, the Belgian engineers have constructed some 10 kms. of dikes, hundreds of bridges and thousands of culverts. One of the bridges is over 800 meters long.

All existing roads had to be straightened, widened and repaired. This work covered about 400 kms. of wagon road, and required 500,000 tons of stone and an equal amount of sand, that is to say, the transportation and handling of a billion kilograms of different materials. Roads are kept in constant repair. Besides wagon roads, there are many kilometers of infantry and artillery trails.

Varied Construction

As the German artillery had destroyed every building within several miles of the front, and as the reserves had to be kept within striking distance in case of an attack, it became necessary to construct barracks for 100,000 men and stables for 15,000 horses. The construction is adapted to the necessities in each division sector.

First aid stations, dressing stations, and emergency operating rooms had to be built and bomb-proofed near the front. Vast hospitals of several thousand beds capacity had to be constructed to take care of the wounded who could not be evacuated to the rear. The hospitals at Panne, Adinkerke, Hoogstade, and Bevereu on the Yser, are thoroly up-to-date and well equipped. They are models of their kind. Even in the bombardment zone marvels have been accomplished in hospital construction and equipment.

Aviation fields, aerostatic stations, workshops, storehouses, repair plants, have all been constructed, tho the country offered practically no resources for the work.

Artificial Masks.

Practically all works have had to be screened from the Germans. For this purpose branches, brush hurdles, and cloth screens have been used. The country is flat and offers no natural cover whatever. All screens are made to resemble the terrain.

The transportation difficulties incident to the construction of these masks can hardly be realized. In the first place the material had to be gathered and shipped by rail or boat to the shops. From there it was shipped to zone of the advance, and then carried by men up to the advanced locations and placed in position. Great quantities of marsh reeds have also been used in hurdle construction. Tens of thousands of square meters of masks have been constructed and placed in position. The wind is very strong in Flanders and constant repairing and replacing of masks is necessary.

Drinking Water Supply

After the battle of the Yser, and following the inundation of the lands, most of the wells were rendered absolutely useless. In order to supply the men with drinking water it has been necessary to go back into the zone of the line of communications and dig wells from which the water is piped and carried to the points of consumption. Wells have been dug, some of them to a depth of 125 meters.

Telephone System

The most ardent advocates of telephonic communication never thought this means of uniting the various elements of an army would be used as extensively as it is to-day. It joins the sentinel in the advanced posts to the army commander; it unites the men who command with those who execute the orders. The extent of the telephonic nervous system of the Belgian army may be judged from the fact that the military telephone lines cover a distance of 21,950 kilometers, of which 6600 kms. are submerged or buried, and the rest stretched on posts. There are about 8000 telephones in use beside the field instruments.

Batteries

At the beginning of the campaign, the Belgians held off the Germans with a small number of 75 mm. cannon and only twenty-four 149 mm. and 155 mm. howitzers.

As the campaign developed, the importance of artillery increased so that it soon became evident that battles were won by artillery fire.

Belgium faced a difficult problem, but the German artillery superiority has slowly diminished until today our front is echeloned with a proper proportion of guns, howitzers and mortars of different calibers.

The preparation of firing platforms and emplacements for heavy artillery was no easy task, owing to the unstable nature of the ground. But cement has been the great saving factor. To-day hundreds of batteries have their concrete emplacements, ammunition magazines and quarters for the personnel.

Batteries are aptly camouflaged, and are further protected by the many false batteries which draw the enemy fire.

(The author ends with a conclusion in which the work, past and present, of the Belgian army is described and praised. The author believes that the morale and spirit of the Belgian army are excellent, and that Dunkirk and Calais are perfectly safe from German occupation.)

[The World War. Events in September, 1917. By Maj. Guggisberg. *Schweiz. Monatschrift aller Waffen*, Oct, '17. 1250 words.]

In September the central powers won two successes: the taking of Riga and the defense of Monte San Gabriele. Preparations for the former were made with great secrecy. Sept 1 bridges were thrown across the Dwina near Uxkull, and cavalry crossed. Simultaneously frontal attacks were made on both sides of the Mitau-Riga road. The Russian 12th Army evacuated Riga Sept 2nd, and General von Hutier's forces entered on the 3rd. Three weeks later von Schmettow broke thru the Russian lines northwest of Jakobstadt, causing the Russians to abandon the bridgehead. Schmettow took Jakobstadt on the 21st, and occupied the front Lievenhof-Stockmanshof.

Monte San Gabriele acquired tactical importance by the fall of Monte Santo, and it was of strategic importance because it dominated the approach to the Plateau of Tirnova and entrances into the Wippach Valley, also the Panowitzer wood and the heights of San Marco. The Italians took San Gabriele at the beginning of the month, but were driven out. An Austrian counterattack on the 6th and 7th nullified Italian successes at Flondar and Medeazza. The Italians gained the village of Selo on the Cottanjevica plateau.

On the west front the English attacked in a south easterly direction near Ypres, Sept 20. The Ypres-Menin road crosses a ridge, about 65 meters high and 3 kilometers long, covered with woods. The attack succeeded in forcing the Germans from these woods and back across the Basseville brook toward Gheluvelt. A German counterattack on the 25th was unsuccessful. After artillery preparation the English (12 divisions) attacked between Langemark and Nollebeke, and captured the Polygonal wood and Zonnebeke. A notable feature was the mathematical precision of the English artillery fire. The attack was carried out by the Lancashire regiment south of St. Julien, by Scotch and South Africans near Frezenberg, and Australians and troops from the northern counties of England on the Menin road. In the German defense, the three regiments of the division were side by side, one battalion of each in the first line, one battalion of each in the second line, and the remaining three battalions forming a reserve. The artillery was four to seven kilometers in the rear.

In Macedonia the left wing of the French forces moved forward from the Devol river and forced the enemy back to Pogradec-Udnuista Sept 12. In Mesopotamia the English captured strong Turkish forces at Ramadie Sept 29.

[The Lesson of the German Drive. By Lieut.-Col. Paul Azan. *National Service*, Apr, '18. 1800 words.]

Offensive strategy consists in choosing zones of attack, in striving to capture in each of these zones a series of positions echeloned in depth, and in attempting to occupy zones of such importance that the enemy will be compelled to evacuate the adjacent zones and to re-align his front farther back. This is exactly what the Germans have tried to do in their offensive toward Amiens. The combat there developed the four invariable phases, whose cycle inevitably reproduces itself: preparation of attack, attack, pursuit and march of approach.

The Germans, desiring to effect a surprise, greatly shortened the artillery preparation, but made up for this in its intensity and in the greater importance which was attached to the rôles of the other elements. The attack was conducted in accordance with the regular rules, in waves, with fresh troops constantly poured in to relieve their exhausted comrades. The pursuit was effected with the formations and by the use of the arms peculiar to this phase. When this phase is extended to a considerable depth, it is because the positions in rear of the front line are either non-existent, or unoccupied. Sometimes by dint of speed and surprise, successive positions may be carried one after another; but when the attacking troops encounter a position which is strongly organized and bravely defended they must necessarily halt. The duration of the pursuit is determined by two factors: (1) The encountering of a position of sufficient strength to resist; (2) The difficulty of moving up heavy artillery. These two reasons, operating simultaneously, have held up the German pursuit. There is no evidence in this of any change in the character of warfare.

The Germans are carrying out all the principles of the war of positions. They attacked, moreover, as was to be expected, at the point of junction of the French and British, counting on a lack of co-ordination and of liaison to help them win.

The German attack in the Armentières zone must not be thought to spring from the fact that the attempt in the Amiens sector failed. It must be part of a strategic plan and have been long foreseen. It is not the last blow in a battle which may last several months.

But the present situation of the Germans is not free from grave dangers to themselves. In the first place they have sacrificed thousands of lives, thereby disorganizing whole divisions and depleting the reserves capable of attacking somewhere else. They also now occupy deep salients unfavorable and even dangerous to their advanced troops. On the other hand, the British zones of Arras and Ypres constitute two salients dangerous to the defenders. The question is, which of the two adversaries will cut the other's salient and straighten out the front forward?

EUROPEAN WAR—Continued

[The War on Land. *Army & Navy Gazette and Broad Arrow,* Apr 13, '18. 1000 words.]

A dispassionate view of what has happened since Mar 20 compels us to acknowledge that the present position of our line, so near to Amiens, is due to our 5th Army having got itself frankly beaten by the Germans. This brought about three regrettable results —the necessary retirement of the 3rd Army, the loss of a large quantity of munitions and of a number of men, and the dislocation of the arrangements our Ally had made for the spring campaign. This last could not but happen, for there was no expectation that the French would be called upon suddenly to extend their front two score of miles. These immediately available units of our Ally effected some remarkably fine pieces of work, as at the fight round Lassigny, and did in fact all that men could do, but their enforced use in this piecemeal fashion quite probably deprived General Foch of the chance of repeating the maneuver of the Battle of the Marne. When an enemy is in full career of advance, you can either throw troops directly in his path, and so be able gradually to bring him to a standstill, or you can check him by a truly strategic counterstroke. The former way will sometimes have the safer look, but can usually end only in a deadlock; the latter may turn the tables completely, causing such disturbance in the enemy's warfare as to snatch from him every shred of initiative. General Foch is the man to plan such a use for his general reserve.

[The Crisis. *Canadian Military Gazette,* May 28, '18. 173 words. Quoted.]

"For two reasons Germany is forced to seek a decision in the field as early as possible. Delay would involve the risk of a breakup in the alliance, which she cannot afford. Her victory in the coming summer campaign must be absolute, or worse than valueless, for Germany will have exhausted her reserves, whilst, even should the Franco-British Allies find themselves similarly reduced, the American army will just be approaching its zenith. From immense preparations Germany thinks she will be able to achieve a decisive victory within the time-limit. The Allies are confident that with the infusion of American troops, whose first draft is already incorporated in French and British divisions, they can withstand the full force of the enemy assault until the American army in the field has grown to the same proportions as those of the French or British. It is a question of time. Every day's delay increases the strength of the American army in France bringing Germany nearer to the end of her time-limit."

[War Notes. By Capt. H. M. Johnstone, R.E. (retired). *United Service Mag., May,* '18. 5000 words.]

I

The opinion has been expressed in these notes for months past that there was no certainty that the German Command was really preparing for a decisive campaign. The Allied Commands have known for many weeks that the Germans were accumulating stupendous strength between Ypres and the Argonne, but this did not necessarily mean an attempt at a decisive attack. However, the presence of such numbers necessitated corresponding preparations.

If Russia and Rumania had remained in the war, the situation would have been very different, and the Allies might have hoped to reach a decision on the western front in 1918. But the situation has changed, and during the first half of the year there is no hope of decision by attack, but a reasonable certainty that any enemy offensive can be sustained without breaking.

Three courses were open to the enemy: to attack with the intention of reaching a decision, to attack for limited objectives, or to challenge attack while waiting for the U-boats and peace propaganda to do their work. The third course would have meant that the enemy believed in his submarines and propaganda. The second course would have been because some action was necessary to encourage the people at home. To attack for a decision meant lack of hope to achieve success by other means.

Immediately after the attack was launched on Mar 21, and before we had begun to use even the local reserves of the army sectors in earnest, our commentators jumped to the conclusion that the "crisis" had arrived, whereas only two of our armies and a part of one French army had been engaged. It is likely that at the end of a week Sir Douglas Haig had not fought more than about 30 divisions out of his great forces. The enemy had probably engaged three times as many divisions, but there was no true crisis possible for either side until the campaign had developed further.

Official *communiqués* and correspondents told that captured maps showed that the Germans expected to make much greater progress than they actually did. No great importance should have been attached to such information. The Germans were using heavy forces and it is quite proper to show the troops a high degree of expectation. One has seen the same thing on a smaller scale on a British attack map issued to a brigade commander. The German Command could hardly have expected the program to lag behind so heavily as it did, but time schedules worked out on paper are very likely to go astray when the adversary is of the quality of the British or French.

The German press spoke of victory in the first two or three days. Then the tone changed, and there was to be hard work and much bloodshed, but still victory would not be delayed long. Within a week, however, the German people were warned by the press not to expect too much, and not to expect impossibilities. Thus the Germans themselves did not believe that they had produced a crisis so early in the campaign. There will be a crisis, but not yet awhile.

II

The crisis of a battle arrives when the attacker is putting in his last reserves, or the last that he intends to use. It is likely that the Germans will keep in hand forces sufficient for a prolonged defense. Thus it is improbable that the present battle will end the war, or that Germany will win a decisive success now or at any other time. To finish the war, the Allies will have to

pass to the offensive. This will be a new battle, in all probability. There will be a pause between the end of the German effort and the beginning of our new offensive. The Allies will try to keep the open warfare going, but when the enemy falls back to his old lines we know that such an organized defensive line is not to be rushed without much preparation.

(Follows more speculation as to the general course of the operations when the Allies assume the offensive.)

III

Now is no time to discuss the causes of the failure of the British front to hold against the German attack. It is splendidly certain that the individual units fought staunchly, even in the army which gave way. Some confusion evidently arose, and this is a condition which can do untold harm in a retreat when the retreat is being vigorously followed up.

Stress has been laid on the German effort to separate the Third and Fifth British Armies, tho the separation of the British and French seems a more likely aim. In any case, there was a day on the Tortille, just north of Peronne, when the Third and Fifth Armies narrowly escaped a loss of cohesion.

The Germans probably had no definite certainty as to the outcome of their attack of Mar 21 beyond a certain amount of smashing in of the then British front. They must have planned simply to exploit whatever success might be achieved. Von Moltke laid down the principle that a supreme command can do no more than plan how to open its offensive, taking care to waste no resource, and then abide by the result of the first collision. Even if success is achieved in the first blow, it cannot be foretold in what direction the chief enemy weakness will result.

The first blow brought the enemy very substantial gains. M. Henry Bidou, in the *Journal des Débats* stated that the Germans had plainly beaten the Fifth British Army, from the command of which Gen. Gough was relieved. The retreat of the Third Army was forced by that of the Fifth. This involved heavy loss of material. The enemy advanced near enough to Amiens to expose the railroad station, and traffic on the Boulogne-Paris line is compromised. More important, the enemy forced the French to go to the relief of the British and to assume charge of more than 60 kilometers of front. This must have interfered seriously with the arrangements and intentions of Generals Pétain and Foch.

When the enemy is gaining ground to an extent that may become serious, the reserve may be used either to strengthen the parts of the line that are giving way or the pressure may be relieved by a counter stroke elsewhere, usually on the flank of the enemy's progress. In the last ten days of March the former course had to be adopted. The French divisions had to be thrown in piecemeal as they arrived, and more than once a complete rupture looked likely. The French Command and the French Staff achieved the impossible in this work of strengthening the line.

"The retreat of the Fifth Army was at first from east to west, and even this direction of movement would plainly tend to create a widening gap between its right flank and the next troops of our Ally on that side. But the gap would be more rapidly increased when the right wing of the Fifth Army began to close northwestward in order to preserve the full continuity of the retreating front of the Third and Fifth Armies. It is difficult in the present state of knowledge to arrive at any judgment of the action taken about the 26th March, but there are signs of want of co-ordination between the British and French. The moment the German offensive opened on the 21st March, one would expect both the Commands (Haig and Pétain) to have an eye upon the junction of their forces with each other, and it looks as if the French chief expected us to be able to look after any widening out that might occur. Lord Curzon said in the Lords on the 9th April that the French General Staff had substantial reason for expecting a strong German attack in Champagne just at the time of the attack upon us, and no doubt the leader of that House was speaking by the book. Thus, those who are inclined to cavil at the slow arrival of the French are unfair in their criticisms."

Some in France express surprise that what was necessary on the south flank of the Fifth Army was not done by the British reserves, and there is some force in the criticism. One of three things may possibly have occurred. Either the German Command succeeded in deceiving the British as to the point of attack; or the Fifth Army was quickly in such plight that our reserves had to be used to prevent its complete rout; or there was a plain misunderstanding between the Allies as to the responsibility for closing the gap. Even these can be stated only as possibilities in the absence of inside knowledge.

IV

After the offensive south of Arras had been slowed up, the enemy delivered an attack between La Bassée and Armentières, followed quickly by one from north of Armentières to beyond Messines. There is a difference of opinion as to whether this was a diversion or a main part of the original scheme of attack. Most people regard the separation of the British and French as the main object of the attack, but if the attack north of Armentières was part of the original scheme, the aim must have been the destruction of the British armies. No sure opinion of the German intentions can be formed for a long time to come. German newspapers before the middle of April were telling their readers that the aim was to destroy Ally divisions and capture Ally guns, and this may be the truth. The German Command probably long ago made up its mind simply to attack, and then proceed according to circumstances. The fresh attack in Flanders is a natural development under this hypothesis. Possession of the Aubers ridge in front of Lille was of great advantage to the enemy in preparing for this attack.

[War Notes. By Captain H. N. Johnstone, R.E. (retired). *United Service Mag.*, June, '18. 5500 words.]

I

By May 1, the Allies had a right to congratulate themselves on the posture of affairs on the western

EUROPEAN WAR—Continued

front following the German offensive. The onset beginning Mar 21 had achieved success rather more than we had bargained for. But on the 29th of April the Germans were heavily repulsed in the region of Mont Kemmel. Our use of troops was beautifully calculated to effect the repulse of the enemy without exposing a single brigade unnecessarily to the devastating effects of modern fire. Divisions were there ready for use, and the failure to use them is not proof that there were no reserves, as some critics assume.

The staunchness of the defense along the line Givenchy-Merville, forming the southern face of the new German salient, has seriously hampered the development of this enemy offensive. On this line the British divisions have held like a stone wall, exhausting many enemy divisions and compelling the use of other troops that might have been used by the enemy to his advantage around Meteren and Mont Noir.

The Kaiser's presence for several days around Ypres might have had two different meanings. Either he may have been there honestly to watch an expected great victory, or his presence there may have been allowed to become known to attract attention there while operations elsewhere were in preparation. In any case, he saw the terrible slaughter of his four very best divisions in a single day on a front of only a few kilometers.

II

German demonstrations have been continuous along the line from the heights of the Aisne to Arras. These attacks proved to be merely local operations, tho there was always question as to the weight which might be behind them. Particularly violent has been the series of thrusts against Villers Bretonneux, and between there and Hangard.

It may be considered that the great opening phase of the German offensive against the Franco-British front ended on Apr 1. The British front was ruptured on Mar 21-22; the Germans then pushed toward the Oise (Mar 23-27) and toward Amiens (Mar 24-28); then followed the attack in the region of Arras (Mar 28-29), and the attack on a sixty kilometer front from Moreuil to Lassigny (Mar 30-Apr 1). After this series of operations, the front ran by the east of Arras along the old British organizations of Hébuterne, west of Albert, Sailly-le-Sec, Hamel, Marcelcave, Hangard-en-Santerre, the eastern skirts of Moreuil, Braches, Cantigny, le Monchel, Rollot, to Orvillers. Eastward, the French had retaken some ground in front of Canny-sur-Matz, and their front ran forward as far as Plémont and reached the Oise in front of Mont Renaud. East of the Oise, the French prepared a line to the south of the Lower Forest of Coucy, but their outposts continued to occupy the marshy region between Amigny and Rouy. With things in this situation, the Germans initiated two fresh operations against the French front.

On the morning of Apr 4 they attacked with great fury on the 15 kilometer front from Grivesnes to the Amiens-Roye road, using not fewer than fifteen divisions, seven of which were fresh. This attack gained the villages of Mailly, Morisel, Castel, and the wood of Arrière Cour, but the wood was recaptured the next day and the line was carried forward to the western edges of Mailly-Raineval and of Cantigny. This attack was prolonged northward on the British front from the Avre to the Somme.

On Apr 6 the Germans attacked on a front from Abbécourt to Barisis, where there had previously been no fighting. Under this pressure the line was retired to prepared positions southwest of the Lower Forest of Coucy and to the south of Coucy-le-Chateau. (This description is taken from French sources, and comment is here made concerning a discrepancy between the actual situation and the official *communiqués.*)

III

Little has become known concerning the effectiveness or otherwise of the assiduous day and night bombing by our airmen, and there has been a certain amount of skepticism. Statements of German prisoners show that this bombing has produced serious effect, and the men complain bitterly that their own airmen give them insufficient protection. The bombing is undoubtedly interfering seriously with German activtes behind the lines and it has a further effect in depressing the morale of the German troops.

IV

Bernhardi's writings reflect more accurately than those of any other German military writer the prevailing military doctrine. This doctrine is to select a plan and then execute it with such vigor as to impose it upon the adversary. In a general way, the enormous number of troops and the enormous amount of transport involved in a modern attack admit of no variation in plan. The French comment that from the beginning (of the present offensive) the German Staff had a strategical plan quite clearly defined. "It was to separate the British from the French by crushing the British right wing. The declarations of prisoners and their marching time-tables strengthen this opinion, and the writings of correspondents confirm it." The idea that the Germans were prepared to push in any direction was true only in a tactical sense, and the general plan has not varied. "This suppleness (of strategical plan) is a French attribute; the German system is just that of Bernhardi: choose a plan and impose it by force."

There is thus going on a test between the minds of two great races: on one side the Germanic genius, executing with undeniable vigor and ability the settled plan it conceived at first; opposed to it the French genius, more subtle and rapid, adapting itself smoothly to unforeseen changes.

The German military critics have lately been comparing Hindenburg and Foch. They know the essential difference of doctrine, and approve their own.

The Flanders offensive has the appearance of an interlude to fill up the time till the offensive in the south can be resumed. Its very success deranged the German plans, but was worth following up on the chance that a weak sector had been hit upon. But it was not according to the German doctrine, and its failure will probably cause them to adhere to the Bernhardi doctrine in the future.

V

(A comparison of German methods in conquered territory with those of the British. The Germans are arousing hostility in Ukraine by the pursuit of their own aims in complete indifference to the feelings and needs of the inhabitants.)

[German Raid on the British Trenches Near La Boisselle, April 11, 1916. Translation of a German Document. *Jour. Royal United Service Institution*, May, '18. 10,000 words. 6 tables.]

(This article consists of two parts:—Part I, Orders for the Raid; and Part II, Report on the Execution of the Raid. Maps illustrating the article are omitted on account of cost of paper and printing.

Part I gives the full text of the regimental orders for the raid; the special orders for the raid; the table of distribution of artillery fire with general and special remarks; the special orders for the feint attack in front of the southwest corner of La Boisselle; the special orders for the feint bombardment to be carried out on the morning of the day before the raid; and the table of distribution of artillery fire for the feint bombardment to be carried out on the morning of the day before the raid. These orders specify in exact and full detail all the operations to be carried out in connection with the raid. An editorial note states that the value of the article lies in its showing the amount of preliminary arrangement required for carrying out even a comparatively minor raid. There are fourteen printed pages covering the matter referred to above, and no condensation of this material would be of value.)

The outstanding statements in the report on this operation are:——the operation was carried out practically exactly as planned; over 6000 rounds of artillery ammunition and 800 *minenwerfer* shells were fired in connection with the raid; the success of the raid was due to the use of gas shells; a raid with gas masks on is scarcely feasible; the feint attack fulfilled its object in every way; dummies arranged to be raised from a prone position to the vertical by strings leading to the trenches were used, and were successful in drawing both machine gun and artillery fire; 24 unwounded and 5 wounded prisoners were captured, the German loss was one man slightly wounded.

[The Americans in Europe. By Admiral Degouy. *The Mil. Hist. and Economist*, July, '18. 7000 words.]

(The writer wishes to draw attention to the advantages and possibilities of a combined attack upon the north coast of Germany, termed the "Northern Front." He decides that this coast is an extremely favorable point for the employment of the American forces. As such an attack would require at least 300,000 men and 400,000 tons of transport, with a large number of light draft gunboats and "bombards," it could not become a reality for at least a year. In the meantime he suggests the preparation of public and military opinion for such an attempt, with the diplomatic negotiations necessary to remove the "neutrality" of a Scandinavian nation, now a barrier to any operation of this sort. He believes that the road to Berlin lies on the "Northern Front," and sets forth his arguments to support that contention.)

[The Condition of the Western Front: The Northern Sector. *Sphere*, July 13, '18. 750 words. Sketch map.]

The warfare on the western front seems to be drifting back into trench warfare. The mass and execution of the artillery are so great that if a rapid decision be not obtained in open warfare, there is no alternative to covering the infantry.

Tanks have been extensively employed in the recent fighting on the western front. The earlier tanks were heavy and slow. Now light tanks weighing from 5 to 7 tons are used where larger machines cannot operate, and the heavier machines have been given increased motive power and thus increased speed. It would seem that the tanks have come into their own. The tanks are better and their management is better understood. The great French counter attack of June 11, which stopped von Hutier's rush for Compiègne, was made by alternate waves of infantry and lines of tanks. The baby tanks were especially effective, on account of their ability to climb steep slopes. Except on hopelessly sodden ground, the tanks are able to render priceless service on the battlefield.

There has been much speculation concerning the quiescent period following June 15. Undoubtedly the important causes are: (1) the time necessary to establish communications and bring up supplies; (2) the hampering work of Allied aircraft; and (3) the necessity of waiting for weather favorable for the use of gas. In using gas shells, the trend of the wind must bear the gas toward the enemy. A fortnight of favorable winds is needed for a successful attack. An examination of the direction of the development of the German offensives supports the theory that the weather and the direction of the wind have had their effect in the choice of time and direction of their attacks.

[The World War from the Middle of Sept, 1914, to the Middle of Feb, 1915. From a Translation of *"Geschichte des Krieges"* by Hermann Stegeman (1917) in *Kungl. Krigsvetenskaps-Akademiens Tidskrift*, Mar, '18. 6400 words.]

A narrative, continued from the time of the battle of the Marne, of the operations on the two principal fronts in Europe, the west and the east.

I. The Operations on the West Front.—The book begins with the retreat of the German armies from the Marne to the Aisne ("mit verbissenem Groll"), continues until the fronts of the English and the Germans reach Pas de Calais, and is then brought up to the 15th of February, 1915. The author does not give any new reasons for the order of retreat of the German High Command. One of the reasons was undoubtedly the sending of two army corps to East Prussia, the tying up of two others at Antwerp, and the necessity of conquering Maubeuge, on the important railway line Luttich-Namur-St. Quentin, behind the operating armies, for which the Seventh Reserve Corps was employed.

The German armies under Kluck, Bülow, and others

EUROPEAN WAR—Continued

effected the retreat to the Aisne under very difficult circumstances, and it is a question, whether especially Kluck did not find himself in a more dangerous position there than at the Marne (Ourcq). He was threatened on both flanks, and for a moment it looked like destruction for him. Especially two circumstances brought salvation and enabled the Germans to stand at the Aisne: the fall of Maubeuge on the 8th of September and the transfer of the 15th Army Corps from Elsass to the right wing of the German armies. Thru the fall of Maubeuge the Seventh Reserve Corps under Zwehl was released. By forced marches this corps went thru Laon and relieved the German troops at Craonne. The danger had not passed, however. But as the battle on the Aisne, which had developed from the battles of retreat, reached its critical stage, the 15th (Strassburg) Army Corps under General Deimling arrived by rail.

On the 6th of September, the German High Command —probably apprehensive as to the security of the right wing of Kluck—had ordered the Seventh Army, fighting in Elsass under Colonel General Heeringen, to deliver two army corps to the Sixth Army, while the headquarters of Heeringen and the 15th Army Corps, as well as other forces, would be transferred to the right wing. The transportation by rail had to be effected via Trier-Aachen-Brussels. The 8th of September Heeringen arrived at Brussels, but was ordered to stay to check an eventual sally of the Belgian Army from Antwerp, which was effected the following day (one German regiment participating). Sept 10 Heeringen, now in command of the Seventh Reserve Corps, continued to St. Quentin, and the 15th Army Corps was directed via Laon to prevent the flanking of the German right wing. The hopes of the English and French of a breaking thru of the German lines were shattered, the regrouping and reorganization of the German troops could be effected. The fall of Maubeuge on Sept 8 was of tremendous importance. Zwehl's forces were inferior to those of the French on this occasion.

The Germans, having entrenched themselves at the Aisne, now began the attempts of flanking of the left wing of the enemy, met by the same attempts by the French and the English aiming at the relief of Belgium and Antwerp, which was being besieged by General Beseler. During two months, steadily lengthening the lines northward, the battles of the Oise, between the Oise and the Somme, at Ancre, Arras and Lens, Lille, Ypres and the Yser were fought. There were two circumstances also at this time which favored the Germans: the regrouping of the English Army and the fall of Antwerp.

Field Marshal French, during the flanking battles at Ancre at the end of September, insisted that General Joffre should relieve the English troops at the Aisne in order that they might reoccupy their former position on the extreme left wing, which justly belonged to the English being near to their base, and from whence they could best serve "the defense of England on the continent." As everything depended on keeping Flanders and relieving Antwerp, the British Army ought not to wait to change their position.

General Joffre heard this request "mit gepressten Lippen," but in spite of the inconveniences connected with such a regrouping, and the success of the flanking movements within a hair's breadth, he gave in to the English. During the preparations for the regrouping, the fighting about the ground round Antwerp began, and before this regrouping was finished, the fate of Antwerp was decided. In the attack on Antwerp General Beseler employed a shorter procedure, altho his forces were inferior to those of the Belgian Army and the garrison. On the 9th of October the civil authorities, and on the 10th the military governor capitulated. The regrouping of the forces evidently caused the delay in relieving Antwerp. The flanking movements were continued. Every move was met with new German fronts formed of troops released from the Aisne or newly organized ones. Presently the armies of Crown Prince Rupprecht of Bavaria and Duke Albrecht of Wurtemberg in larger or smaller parts were moved to Flanders. A sanguinary struggle began for the possession of Lille, which remained in German hands, as well as the important crossings of the Lys.

The battles about the flank terminated with the battles of Ypres and the Yser without the desired result of flanking for the French-Anglo forces. The wings were now extended to the coast, and the war assumed the character of trench warfare.

The fortifications on the Aisne had made the transfer northward of troops possible, but for parrying still more units were necessary which were formed by a large number of volunteer regiments, the flower of "Jung-Deutschland." In spite of the greatest enthusiasm, they were not equal to the particularly difficult character of the fighting, and the defeat of the flanking movements of the enemy was dearly paid for.

Undoubtedly the time from the battle on the Marne up to the battles at the Yser and Ypres was a very critical period for the German arms. In comparison with the brilliant successes of the August offensive the Germans suffered a serious set-back, but on the other hand the enemy did not succeed in defeating them and were not able to utilize the German retreat, but from the middle of November had to stop in front of a line which extended from the North Sea to the Swiss border. In spite of having brought the Anglo-French offensive to a stop, the Germans were in the west confronted with the immensely difficult problem of holding the long front with comparatively weak forces in order to operate strongly in the east, where a decision was to be sought. The initiative was thus left to the French-English forces, either to try to break thru or, in view of the operations in the east, to start counter offensives. The French would have to shoulder the heaviest load in such an offensive.

Joffre aimed at a general offensive along the whole front from Belfort to the coast. The whole German front would be attacked if possible simultaneously, in order to prevent the Germans from using their reserves at certain parts of the front.

The general order of offensive was given Dec 17, 1914, and the fighting began. At the coast, Ypres, in the neighborhood of Lille, Lens (Souchez, Lorette, etc.), Arras and Albert, on the Aisne, in Champagne, in the

Argonne, at Verdun and in the Vosges. The hardest fighting took place at Soissons, where General Maunoury commanded the French, also called the battle of Soissons. The French attack was carefully prepared thru the work of sappers, so that only the hand-to-hand fighting remained. In the beginning success favored the French and the Aisne was crossed, but an energetically executed counter attack robbed Maunoury of the fruits of his exertions. He had to leave 5000 prisoners, many dead, 18 heavy and 17 light guns on the right bank of the Aisne. The intended breaking thru at Soissons in the direction of Ailette had ended with a severe reverse. With it the great offensive of Joffre stranded. It was characterized by a dispersion of forces against the whole front instead of their concentration against a certain part of the position of the enemy.

Not only had Joffre's offensive been a failure, but it had come too late to help the Russians who were already defeated when Joffre gave the order of attack Dec 17. As an operation with independent aims it came too early, because the English were not able to participate with any large forces. It was a serious mistake, Stegemann says, to try to unite two such different things as an offensive to relieve the pressure on another front and an independent offensive, and to fight with scattered forces, all of which is against the principles of liberty of action and the concentration of forces.

The French were, however, determined to repeat the general offensive on a new basis. The German line was to be attacked at its most vulnerable point, and the result of this plan was the first big attempt at breaking thru, the winter battle in Champagne, which belongs to a later period (next book) of the Stegemann narrative.

. . . .

[Remainder of this article under "General Notes on Operations, by Theaters, Eastern Front."]

[Notes on the Vosges Front. Echague, Benítez, Ullà, and Suaréz. *La Guerra y su Preparación,* Aug, '18. Diagrams. Photos. 1200 words.]

Village Precautions Against Bombardment

Statues and arches are covered with sandbags. Cellars have within them other cellars hermetically sealed against gas, and heavy roofing of reinforced concrete. Filter curtains chemically treated are hung in all doorways of shelters. Some have raised floors to give the gas a collecting place. Gas shells, which are generally of 150 mm. caliber, explode with comparatively little violence, and their noxious range is about 50 meters. Cloud gas in a low wind remains for at least two hours. In addition to cellars, masonry shelters are constructed in the streets, one wall coinciding with the house wall. Entrances are defiladed by traverses.

Vosges Front Line Works

Invisible gases invariably give warning by whistling sound on liberation. Their rate of travel is twelve kilometers per hour. Observers, machine gunners and automatic riflemen are kept on post, all other men in shelters. Second line trenches have become the main line of defense, and are manned accordingly. Ammunition and illuminating rockets are kept in pockets dug in interior slope. In many places ground water prohibits deep shelters, and recourse is had to logs and cement. All entrances are defiladed. Concealment is effected by use of wire netting and brush. One mortar battery is mentioned on a steep reverse slope, with shelters cut into bed rock. Guns in use are the 240 mm. piece, mortars of 220 and 280, and the newest Creusot of 155 mm. Long stretches of road are hidden by overhead screening. The authors foresaw a future drive in this spot.

Pigeon houses are marked at night with different colored lights to guide the birds in night flying. There are also portable pigeon houses. Gas affects these birds but slightly.

There is much aerial cable transportation by electricity, which cuts off much distance due to the winding mountain roads. Dog teams and sledges are extensively used, together with mules and horses. Artillery depends largely upon aviation for its observation, but here the visibility is frequently poor. Sound ranging is of extremely difficult application, due to intense echoes in the mountains. Cavalry is armed with the automatic rifle and the grenade, and does infantry duty. Cyclists are hampered in this respect, as their whole equipment is carried on the wheel, and they cannot leave the machine.

Projecting spurs give many points for enfilade by machine guns. The lines are in many places so close as to render the use of trench mortars dangerous to the users. Many communications are entirely covered; certain ones for the evacuation of wounded are to be used from front to rear only.

All officers of the regular establishment have by this reached the grade of Major, the lower grades being filled from the ranks. In General Staff duty, men from the ranks fill position of G 1 and G 2, leaving G 3 to graduates of the School of War.

A Second Lieutenant commanding a battery of two 120's and two 90's has also at his command six 75's for barrage fire.

The 120's are 40 meters apart, the 90's, 19. The observer has triple telephonic and also visual connection.

Aviation

The Nieuport now has ailerons in place of warping tips of 1915, and a spread of 15 meters. The Morane-Saulnier has adopted the Sopwith rudder. There are many new model Spads, with the Hispano-Suiza motor.

The Germans use a bullet with a tracer, the composition of which is unknown. It is used one in ten in machine gun ammunition against aircraft. The French claim it is unsatisfactory, as due to its lightness and wobbling, the trajectory is not the same as a regular bullet.

Sanitation

One regiment visited was in double roofed wooden barracks, lined with tarpaper. Hot water showers accommodated ten men at once, and there were wash and laundry rooms. Food refuse was carted away, tins, metal, etc., salvaged, and all else incinerated. In-

EUROPEAN WAR—Continued

cinerators were of the most simple type. Latrines were flyproof and disinfected daily. In the trenches the latrine is placed at the end of a turn so that when filled successive latrines may be dug in the same return. The latrine is always commenced at a lower level than the main trench.

In an advance, water may not be used until analyzed, this due to poisoned wells. Battalion wagons carry at least one litre of water per man for use pending analysis. The war has proved the success of purification by chemicals; use of chlorine and potassium permanganate is highly efficient. Isolated troops use purifying tablets of hypochlorate of calcium and chloride of sodium. There are regular water purifying stations, with an organized carrying system. They assume the minimum for a man in the field to be 1½ litres per day.

The allowance of stretcher bearers is now seven per company. One medical officer goes forward with each battalion, with his stretcher bearers and several nurses, establishes his battalion aid station, keeps what assistants he needs, and sends the remainder forward. The second line being the point of resistance, the station is there. It is always in a dugout. The regimental aid station is about a kilometer to the rear.

Mention is made of an Alpine hospital, three surgeons, 100 men and various matériel.

The Divisional Sanitary Service travels in six wagons; six surgeons, 38 men and twenty litters. A divisional stretcher group has two surgeons, and 116 men. There are three organizations, each of 16 men, to a division, who carry the matériel to change an ambulance company into a field hospital.

An Army Corps has an evacuation train of 40 ambulances.

Photographs show a variety of types of litter, folding, wheelbarrow, side car, two wheeled, pick-a-back, dog sled, etc.

New Gas Mask

The Tissot Respirator has a mask of soft rubber, separated from the face, enabling spectacles to be worn, and having the interior ventilated thru the reservoir, thus preventing fogging. The region around the mouth is entirely isolated. Exhaust is in front of mouth. The reservoir is carried on the back, loaded with solids in layers. These are supposed to be copper and cobalt salts. A supplementary reservoir may be screwed on to the bottom of the original. Reservoir is hermetically sealed when not in use. This mask will not cause discomfort even during extreme physical exertion.

[The Great German Defeat in the West. By E. F. *Sphere*, Oct 19, '18. 1000 words.]

The urgent request and suspicious readiness of the new German administration to accept President Wilson's "Fourteen Points" for peace were the logical result of a series of disastrous German defeats ending in a general retreat.

The crushing of the St. Mihiel salient was the preliminary to an offensive in Champagne. Here General Gouraud's 4th Army with the Americans on his right had waited since a victory on July 15. On the morning of Sept 26, the 1st American Army, directed by Pershing himself, began an attack which nothing could arrest. One battalion even carried itself so far as to be isolated for four days until rescued by the advance. The German line was penetrated seven miles on the right along the Meuse, while Gen. Liggett's Corps captured Varennes after a furious resistance. Gen. Gouraud's 4th Army advanced between Reims and the Argonne, on the left cautiously, but on the right crashing thru the German defense system and capturing Tahure and Souain. The Americans and French captured 19,000 prisoners.

On Sept 27, Field Marshal Haig with his 1st and 3d Armies and a division of Americans, assaulted the Hindenburg line. In three days he had broken it into a series of disconnected fragments north and south of Cambrai, taking 22,000 prisoners and 300 guns. Farther north, the Belgians and 2d British Army under King Albert attacked between Dixmude and the Lys. They were assisted by British naval vessels and carried Houthulst Forest, Dixmude, Passchendaele and several other places. Some 10,000 prisoners and 200 guns were in their hands.

Thus in four days' battle, the crippled German army lost 51,000 men and 700 guns, besides enormous losses in killed and wounded. A general yielding was the result. On Oct 1, St. Quentin was taken by the French, with the British in the suburbs of Cambrai. Then Le Catelet and Armentières went to the British, and Challerange Junction to Gouraud.

The final assault came under Sir Douglas Haig on Oct 8. Over 12,000 men and 200 guns were captured. Cambrai fell next day and on the 13th, the British were at Douai. Gen. Mangin took Laon with the Aisne Ridge and the St. Gobain Massif, while Vouziers Junction went to Pershing and Gouraud. Eighteen days fighting lost for the Germans, besides their men, a colossal amount of artillery and enough machine guns to surely cripple them.

EASTERN THEATER

See also
MASURIAN LAKES, BATTLE OF THE
RIGA, CAPTURE OF

[Forces Under Lt.-Col. Wolf in the Offensive Between the Nida and Vistula Rivers. By Lt.-Col. Wolf, Austrian Army. *La Guerra y su Preparación*, Aug, '17. 2000 words. 1 map.]

During the offensive between the Nida and the Vistula Rivers, I received, from Headquarters, an order to establish contact between the 1st Field Army (Gen. Rankl) and the German Field Army under Gen. Von Woyrsch. My command consisted of 3 battalions and 3 machine gun sections of the 84th Infantry Regiment. 1 six gun battery, ½ squadron of lancers, and the combat trains of these units.

After a night march, the column assembled at 5 a. m., May 14, at Daleszyckie with orders to march, that day, on Stupia-Nora.

Because of the preceding night march and the premature summer heat, Stupia was not reached until 7 p. m. There, it was learned from a Catholic curate

that the Russians had abandoned the place that day, two regiments of infantry and 18 pieces of artillery leaving at 8 a. m., followed by a rear guard of 3 squadrons of Cossacks at 3 p. m. The 2 columns marched in the direction of Ostrovice.

This circumstance and the fact that my troops had received no combat exercises for various months, persuaded me to advance on the village of Wasuiow, which place, under my orders from the Army Commander, I was supposed to reach on May 15. These orders were issued on the supposition the Russians would take up a position in the heights E. and S.E. of the town. At 10 a. m. on the morning of the 15th, the movement had been completed, and I was in combat formation with the artillery prepared for action, on the heights 2 kilometers to the S.W. of Wasuiow. This formation was received by lively artillery fire from the heights E. and N.E. of the town and by heavy infantry fire from the direction of Prusinovice-Wasuiow-Boksice. At the same time, returning cavalry patrols reported that the outskirts of these towns were strongly occupied by Russians.

My combat formation was such that I immediately returned the enemy fire with my battery, 2 machine gun sections and 2 battalions of infantry.

Knowing that the Russians outnumbered me 2 to 1; that my troops were receiving heavy artillery fire from the direction of Kotascyn-Nosow-Momina; that the extreme S. flank of Von Woyrsch's German Army was engaged at Wielo-Borowice; and that the 25th Company of light infantry (which should have maintained the liaison with the 25th Division) was engaged at Yezow, I decided, after an estimate of the situation, to hold my position for the time being at all costs.

The 3rd battalion, which was in reserve, I ordered to advance upon Kowalkovice on my southern flank. I then reported my situation to neighboring forces. Capt. Wamberzki, the liaison officer with Count Bredow's German Division reported the position of this division to me. It was in action near Drombowa and maintaining contact with my detachment by means of a section of cavalry, which was then near Wiekoborovice. I received no further reports from this division, except that in the afternoon, violent artillery fire was heard south of the woods near Olszoncia. At the same time my cavalry patrols reported enemy troops marching on the Ostrovice-Opatow Road. Some of these troops deployed against my southern flank, for which reason I prolonged my firing line with the reserve battalion to include the heights of Yezow. As several squadrons of Cossacks had been discovered in the Wisoslavice Woods, I sent one company and a machine gun section against the town in order to prevent any turning movement from this direction. These were my dispositions at dusk.

During the night I received an order from the 25th Division to send one battalion to Kunow to establish contact with Bredow's division and to advance with the rest of my detachment on Ostrowice. This movement could not be executed without engaging the Russians. The battle started at dawn on the 16th of May, with my entire detachment minus one company in the fire action. At noon, the company of light infantry retreated from Stryczowice, and as it had suffered more than 50 per cent of casualties, I sent this company to Kowalkowice in reserve. It became impossible for me to follow out my orders to advance on Kunow, as I was opposed by a vastly superior enemy, and, if I had advanced, the interval between my command and the 25th Division would have been greatly increased. This fact was understood by Capt. Wamberczki. At night, my position began to receive fire from both flanks and I sent in the fourth report on my situation to the 25th Division Headquarters.

On the night of May 16-17, a Russian attack was repulsed. One platoon of the battery took a second position behind the southern flank of my forces. On the 17th day of May, at dawn, the liaison officer of Bredow's Division notified me that his division had retired to the heights S.W. of Dobrowa, and that, at Headquarters of this division, it was thought that I had been thrown back to Stupia. I notified this officer that I had not yet received any information whatever on the situation of the 25th Division, and that in view of the general situation and the development of the local engagement, I would remain in my position for sometime longer.

During the morning, the Russian artillery and rifle fire became even stronger. At noon, I sent a full report, in duplicate, of my situation to the Headquarters of the 25th Division. The commanding officer of the company of light infantry requested authority to establish contact with the 25th Division over the Kunin-Piorkow route as firing had been heard in that direction, and each time more toward the west.

In the afternoon several infantry and Cossack attack delivered on my south flank were repulsed. My battery commander notified me that he had received rifle fire from the north. A retreat, at that time, would have resulted in the complete destruction of my forces, so I decided to hold my position and thus protect the retreat to Stupia. My positions were admirably situated and protected.

At 5 p. m. an officer of lancers reported as liaison officer from the 25th Division that his division had been in retreat since early morning and that its north flank had reached the heights S. of Yaqow. He also told me that the 25th Division had only counted on a part of my forces being in Stupia. At the same time, the liaison officer of Bredow's division arrived and notified me that Bredow's division was holding the heights S. of Dobrowa, and that 6 squadrons of cavalry would reach Chybice by dark.

I communicated to my various subordinates the decision to remain in position until dark, and then to seek contact with the German troops.

The withdrawal was executed in silence, and under cover of rain, so that the Russians did not become aware of it. The retreat was done by battalion from the south flank to a position on the heights E. of Nieczulice. While waiting the arrival of the last battalion, at 11.45 p. m., I received the following verbal order: "An order received at Headquarters, Bredow's division, from the General Staff of the Field Army,

EUROPEAN WAR—Continued

directs that the detachment under Lt.-Col. Wolf move immediately to Stupia and join a German detachment which is already there." I notified the officer of my situation and he told me that a German major of Hussars was awaiting me at Stupia. I sent him word that I would be there about 4 a. m. I did arrive at that hour and found a German officer awaiting me, who told me that the Chief-of-Staff of Bredow's division wished to speak to me over the telephone. The latter notified me that my detachment and that of the German Col. Gartner were under orders to support a new offensive of the 25th Division by advancing on Yaqow, and that I would receive my orders from Col. Gartner at 6 a. m. at Stupia-Nora.

I left my detachment at Supia-Stara taking possession of the farm, and proceeded on horseback to Stupia-Nora, where Col. Gartner ordered that the two detachments should march in one column on the Wolka-Yaqow Road. My suggestion that the march should be made in two columns was not taken into consideration. Later on, Col. Gartner said that my detachment was very weak. This statement I denied energetically, as in the three days fighting I had only suffered 7 per cent of casualties. I have not mentioned the fact that when we found the German detachment at Wolka at 8 a. m., the Russians were still firing fiercely upon the positions evacuated the night before.

When the head of my column, which was in the rear of the Germans, reached the village of Wola-Zamkowa, the Germans halted. Col. Gartner rode up to me and said:

"Your division does not attack. I was not sent to be on the defensive. I will return to Stupia."

I answered him, "Then, first of all, I will re-establish communication between the German and Austrian armies."

My detachment gave way to the Germans, who withdrew, and, changing front by battalions, we marched to the wooded hills between Plucki and Tarzcianka. I was glad to get out of the valley road. If the Russians had moved faster, they could have inflicted enormous losses on us there. As it was we had barely occupied the edges of the aforesaid wooded hills, with one battalion in reserve, when the Russians moved on to the valley road from the Yeleniowska Woods. My forces were in a position to open fire, however, and did so, causing the Russians to move back into the woods.

I immediately sent reports on situation to the 25th Division earnestly requesting that I be sent ammunition and supplies, as I had been operating since the 13th of May without ammunition and supply columns. Both ammunition and supplies reached me on the morning of the 19th of May, and a little later, the order came to place my north flank on the enfiladed Trzcianka Road so as to maintain contact with the German flank at S.W. Krzyz.

The order was executed by nightfall by moving the reserve battalion and the battery to the wooded hill S. of Trzcianka. The Russians were not aware of this movement.

Before dawn on May 20, a Russian attack on the Trzcianka Road was repulsed, one battalion capturing 293 prisoners, among them 2 officers; furthermore the Russians were thrown back behind Wolka with heavy losses.

In the meantime the advance guard of Brig-Gen. Le Gay's cavalry division arrived with orders to collect and protect my forces. The General, seeing my position, realized that I had been protecting his advance. The prisoners were turned over to the cavalry division at Bartoszewiny. On May 21 the cavalry division commander called on me and received a full report on what had occurred since May 13, praised the work of the detachment and assured me that I would be relieved by his forces that night and would be sent to the rear in reserve.

At noon I was called to the telephone station which had been established at Trzcianka and received instructions that the detachment would remain under the orders of the second army corps commander. In the afternoon I received an order to attack Yeleniowska and take the stream which runs between that place and Gora Sczyniak, D 552. This attack required an artillery preparation and a partial occupation of my lines by the Cavalry Division.

Before dawn on the 22nd all was ready for the attack, but it was revoked in a counter-order from the 25th Division, according to which the Russians would attack early that morning along the entire line. As this attack was not carried out I launched my own after notifying Headquarters of the 25th Division. It was all over by noon of the 22nd. This was the start of the Austro-German offensive on the Vistula.

My losses from the 13th to the 22nd of May, both inclusive were 297 men, 19 horses and 7 pack animals.

[The 44th Infantry Division (Russian), Oct 18-Nov 3, 1914. By S. Dobrotin. *Voenny Sbornik*, July, '17. 7000 words.]

On Oct 5 and 6, the 44th Division was on the left bank of the San River, in contact on its right with the IXth Russian army. Information concerning the enemy appears to have been lacking, for not until 6 p. m. on the 7th was news received from Corps Headquarters that strong hostile forces were holding a line in the vicinity of Grbov. As these forces seemed to be superior to the available Russian forces, the 44th Division received orders at 4 a. m. the following morning to retire to the right bank of the San, leaving a rear guard on the left bank to cover the movement.

The 44th Division carried out this order without interference from the enemy, taking all of the 8th instant to do so, due principally to the need of throwing a pontoon bridge across the river. The 175th Infantry was designated as the rear guard, and, of course, remained on the left bank of the river near Rudnik. On information that an Austrian advance guard was approaching, the rear guard was withdrawn

on the 10th to the east side of the river, without having become engaged.

Very little change in positions took place in the next few days. There were many rumors of hostile movements, but there do not appear to have been any regular steps taken to verify exactly what hostile bodies of troops were in front. It was, however, commonly believed that the enemy was in great strength, and at one point two Austrian infantry regiments, with four batteries of artillery, were identified. On the 16th the Austrians sent a reconnoitering detachment across the river during the night, leading to a sharp fight the next morning.

At 10:30 a. m. on the 17th orders were received from Army Headquarters for a general advance to commence at 9 p. m. that night, at which hour the 44th Division was to force the crossing of the San, in conjunction with other Russian troops on both its flanks, with a view to drawing as large a hostile force as possible to their vicinity.

As the Division was holding a front of about 12½ miles, the advance guard detailed to initiate the crossing was made up from details of all the infantry regiments, 26 companies out of 48 being taken. The crossing was to be made opposite the town of Zarzycze, but altho favored by a very dark night, the ponton company was so slow that at 3 a. m. only three pontons had been laid, and not until 4 a. m. were any Russian troops across. The morning turned out to be foggy, which was fortunate for the Russians. Having by 8 a. m. accumulated a force of about two battalions, an advance was made against the nearest enemy trenches. The Austrian artillery opened fire at 9 a. m., firing heavily against the point of crossing, but apparently with slight effect. Severe fighting followed, the Russians pushing the crossing of their men with vigor, and attacking at once all in their front. The Austrians made several counter-attacks during the afternoon, and again after dark, continuing the fight until 3 a. m. on the 19th, but all attempts of the Austrians to dislodge the Russians failed.

On the 19th the Austrians attacked in force. From prisoners the 6th and 14th Corps were identified, and the 14th, 28th, 59th, 77th and 99th infantry regiments. These attacks failed, and towards evening of this day, the Austrians showed signs of exhaustion, altho information was at hand that considerable reinforcements had reached them. Under instructions from Corps Headquarters a Russian bayonet attack was made at 10 p. m. this date, and a strongly contested wood was gained.

On the 20th the Russian advance made little progress; shortage of supplies and munitions were reported. Further attacks by the enemy were repulsed, and the 5th, 9th, 10th, 33d, 45th and 77th regular and 17th Landwehr Austrian regiments were identified. On the 21st the fighting continued, with the Russians still on the defensive. On this date the commander of the Russian ammunition train reported that he not only had no more ammunition for issue, but that the horses were so exhausted that they could hardly move. The Russian losses are reported to have been about 2000 for this and the preceding three days. The enemy's losses are stated to have been heavy, but no figures are ascertainable. The only booty captured seems to have been two machine guns.

Continued fighting occurred on the 22d, on which day the Russians attempted to advance further. They had but small success at this, but on the other hand the attacks of their enemy were everywhere beaten off. The Russians lost about 1000 men, the losses among officers being especially heavy. The Army Commander ordered on this day all of the troops to assist the 44th Division, to which reinforcements were also directed.

Again on the 23d the Austrians attacked. While the Russians succeeded in repulsing these attempts to dislodge them from the left bank of the San, they were unable to do more than this due to shortage of munitions, which appears to have been a condition existing likewise in the supporting units on both flanks. The succeeding night was fairly quiet, and but little fighting occurred on the 24th, but additional Austrian attacks were made in considerable strength on the night of the 24th-25th.

Desultory fighting took place on each of the succeeding nights, and to a lesser extent during the day time, without either side obtaining any advantage of moment, up to the morning of Oct 29, when considerable reinforcements both of infantry and of artillery having been received by the 44th Division, it again attacked. Only one regiment was used in this attack, and under heavy enemy counter-attacks the advance gained at one point does not appear to have been material. Further fighting took place on the next two days, during which the Austrians used heavy artillery with a view to interrupting the crossing of the San.

On Nov 1 the Russians decided to make a bayonet attack at 5 a. m., with intent to finally drive the enemy away from the vicinity of the San River. The attack was made as before by a single regiment on the village of Nisko. This village caught fire just before the hour fixed for the attack, which, however, was made on schedule time, and succeeded in seizing all of the town except a few buildings. As usual the Austrians promptly counter-attacked, continuing their attacks thruout the ensuing night.

On Nov 2 the Austrian forces commenced to retire, but, altho this fact was noted by the Russians, no effort at a pursuit was made until the next day, and then not before noon. During the following two days some 3000 prisoner were secured, but no fighting of importance occurred.

This ended this particular phase of this campaign. The Russian losses as reported by themselves were 16 officers and 673 men killed; 49 officers and 4442 men wounded; 19 officers and 1095 men missing. The booty captured amounted to 12 officers and 2142 men with two machine guns. This statement does not cover the last days of pursuit.

(In this account the principal faults of the campaign appear to have been failure of the ponton company to throw its bridge over the San in time, with

EUROPEAN WAR—Continued

the result that at daylight only a very weak force was across the river, and had it not been for fog it is doubtful if this force could have maintained itself. As it was the Russians held their positions on the Austrian side of the stream, and in fact extended them slightly, but only at great effort, and the Austrians finally retreated apparently for reasons other than any menace from the troops in their immediate front.

Other faults were failure to provide sufficient munitions, and partial attacks, a relatively weak force being used to attack isolated points rather than the entire force being employed in a general advance.)

[The Austro-Hungarian Direction of Operations During the Night of the 18th of August, 1914. *Kungl. Krigsvetenskaps-Akademiens Tidskrift,* Mar, '18. 1650 words.]

At about the time when the great German offensive against France, after the fall of Liége and the conquest of a great part of Belgium, was in its full swing, the Austro-Hungarian High Command with headquarters in Przemysl, was confronted with a difficult as well as important problem.

Austria-Hungary was to be the main protector on the east front and was to prevent, in connection with the landsturm corps Woyrsch, the Russians from marching into Silesia and Moravia, while the comparatively weak Eighth German Army under Colonel General Prittwitz should safeguard East Prussia. The Austro-Hungarian Army effected its strategical formation in Galicia at the Dneister and the San. The plan was a quick, powerful offensive against the Russian armies already formed and those under formation; in other words, a gain of time in the operative preparedness.

The situation was, on the whole, very obscure. According to a preconceived plan the Russians retreated in South Poland, and things were looking well for the Austro-Hungarian forces which had the following formation (from the right wing):

The army Kovess between Stanislau and the Stryj;

The army Brudermann around Lemberg;

The army Auffenberg at the middle course of the San around Jaroslaw; and

The army Dankl on the left wing further down the San to the Weichsel, in connection with the German corps Woyrsch in South Poland.

The situation began to clear; up to Aug 17 the aerial observations had given the following result:

1. The evacuation of Russian Poland west of the Weichsel was in full swing.
2. The mobilization and formation of the enemy had developed further than was supposed.
3. The Russian frontier corps east of the Weichsel were already formed and partly pushed nearer the frontier.
4. Cavalry masses, supported by strong infantry, were marching up in the neighborhood of Brody.

The High Command in Przemysl ventured on the supposition that large Russian troop masses were at Lublin and at the railway Brest-Litovsk-Ivangorod, but were wholly unacquainted with the enemy forces which might be expected from the east (from the Vohlynian triangle of forts Luzk-Rowno-Dubno) and from the southeast in the direction over Proskurow (in Podolia).

In fact, the Russians were thus grouped: The army Ewerth around Lublin; Plehwe in the neighborhood of Cholm; Ruski in the neighborhood of Dubno; and Iwanow round Proskurow.

These four Russian armies, counting 200 battalions more than the Austro-Hungarian forces and besides being far superior in artillery and still more so in cavalry, were standing in an encircling bow round East Galicia, two armies in the north and two in the east. The Austro-Hungarian formation was not concluded, while the Russians were ready for operations. The question was whether or not to adhere to the original plan—the protection of the east front. During the night of the 18th of August, 1914, it was decided that the main forces (Auffenberg and Dankl) should start the offensive against the north and the northeast, while the forces fronting the east should meet the hostile invasion in the east of Galicia and to the best of their ability should co-operate in a northerly direction. Conrad von Hotzendorf made this decision and never lost sight of it, even during the darkest and most trying hours. German authorities point out this decision as being Hotzendorf's "first great hour in the world war," a decision which would rank the field marshal "among the leaders of great movements."

The Russian attack against Galicia was made from two fronts: From the north (Ewerth and Plehwe), and from the east (Ruski and Iwanow); Hotzendorf's main thought was to attack the nearest and, for the moment, most dangerous hostile forces—the armies Ewerth and Plehwe.

A pure defensive might easily have led to a Königgrätz; the problem was to attack at the right moment on a sufficiently broad front, and to get the start in the tactical formation.

The offensive implied the execution of an eccentric operation of attack in connection with operations on the inner lines. The condition for success was that the armies of Auffenberg and Dankl should in time defeat the Russian forces in the north round Lublin and Cholm, before the pressure from the east should become so strong that the troops in this direction would have to yield.

The problem was very difficult. Some days after the decision in Przemysl, it was clear to the High Command that the Russian armies not only were nearer, but far more numerous, than previously supposed. At the end of August the situation began to be critical, and on the 11th of September a general retreat was ordered to the other side of the San.

The campaign which resulted from the decision of the night of the 18th of August was full of tremendous difficulties. There were engagements at Krasnik and Lublin, at Zamosc-Komarow, at Przemyslany-Rohatin, north, south and west of Lemberg, etc. If Brudermann had been able to hold out a few days longer east of Lemberg, Auffenberg might have been successful at Cholm and Dankl at Lublin.

Fate would have it otherwise. Thru incessant reinforcements the Russians occupied East Galicia and

marched into its capital, Lemberg. The Austrians withdrew behind the San exhausted—Dankl's army had been fighting for 17 days uninterruptedly—but neither completely defeated nor disorganized.

The positive result of the Austrian offensive was gain of time and the tying up of the Russian forces, thereby making Hindenburg's interference during the latter part of September possible. On the 14th of September, Hindenburg began moving his troops to the south of Poland, and the consequence was some of the most wonderful operations that are known in the history of war. In these operations the decision during "the historical night in Przemysl" has an immediate share.

[The World War from the Middle of September, 1914, to the Middle of February, 1915. From a Translation of "Geschichte des Krieges," by Hermann Stegeman (1917). *Kungl. Krigsvetenskaps-Akademiens Tidskrift*, Mar, '18. 6400 words.]

A narrative, continued from the time of the battle of the Marne, of the operations on the two principal fronts in Europe—the west and the east.

(The portion of this article referring to the western front will be found under "General Notes on Operations, by Theaters, Western Front.")

. . . .

The Operations on the Eastern Front.—In spite of the victories at Tannenberg and Angerburg, the situation in the east in the middle of September, 1914, was very serious for the Central Powers. The Russians under Samsonow and Rennenkampf were defeated, to be sure, but the Austrians had had to retire to the Dunajec where they had to effect a strategical regrouping of their forces, for which time was necessary. Would the Russians allow them to do so?

While the German east army, after the defeat of Rennenkampf at Angerburg, was still fighting in the woods of Suwalki, Hindenburg was ordered to move the main part of his forces to South Poland. He was now confronted with a problem the solution of which offered very great dijculties. He not only had to disentangle himself from the enemy and to transport his troops by rail from Suwalki to Schlesien, but he had to do it unobserved; and sufficient forces had to be left in the north in order not to jeopardize the result of the operations in the end of August and in the beginning of September. The change also required time. There was the danger that the Austrian Army would be pressed back still further before the Germans would get the chance to interfere.

The 14th of September the Russians arrived in front of Przemysl, Sambor and Stryj, while the Austro-Hungarian armies escaped being reached and flanked behind the San by the Russians. This danger was past on the 19th. When the regrouping had commenced behind the Dunajec, Hindenburg's first troops arrived in South Poland. Now a new phase of the operations was opened—the German and the Austro-Hungarian advance on the Weichsel and the San. In the north (west of the Niemen), the remaining German forces pursued with apparent zeal, thereby deceiving the Russians and their generalissimo, the Grand Duke Nikolai Nicolajewitsch. The roar of the battle at Suwalki drowned the noise of the trains which were rolling day and night via Thorn and Posen to the south.

The Grand Duke Nicolai was of the opinion that the center of gravity of the operations was in the north, and accordingly took all the necessary steps to restore the armies there defeated, to reopen the double flanking offensive against East Prussia, and to organize reserves. He considered the Austrian armies beaten and in a panic-stricken retreat. The Russians pursued them slowly on account of narrow fronts of operation. As soon as their bulletins of victory announced the retreat of the Austrians behind the Dunajec, and the conquest of the passes of the Carpathians, the German offensive movement started, Sept 28, from the line Cracow-Kreuzburg on which Hindenburg had grouped his troops. These were formed of five army corps: the Guard Reserve Corps, the 9th, 17th, 20th, and the Corps Frommel. Besides the landsturm corps Woyrsch took part on the right wing. This corps originally was to protect Silesia, but had afterwards advanced with the Austrian left wing in their August offensive. The losses suffered in this and the following retreat had been replaced by fresh landsturm regiments. The Germans were also joined by the Austrian army Dankl, whose right wing followed the left bank of the Weichsel in the direction of Sandomir (where the San joins the Weichsel). Some days later the main Austrian forces moved against the San (against Przemysl, besieged by the Russians, against Jaroslaw, etc.). The joint plan aimed at the defeat of the Russian troop masses between Przemysl and Ivangorod, and to bring them into confusion.

Under great difficulties and on impossible roads Hindenburg and Dankl executed the advance, defeated the Russians in several encounters (at Opotov and Klimontov, etc.) and had the following positions on Oct 7: Dankl along the Weichsel from where it is joined by the San up to Ivangorod, and Hindenburg on the front Ivangorod-Radom-Lodz approximately. The Austrian main forces reached the San line Oct 9 almost without fighting and liberated Przemysl, which Radko Dimitrieff had tried to subdue with all the means at his disposal. It was Hindenburg's blow against the right flank of the Russians which made their front totter.

In spite of the success, the situation on Oct 8-9 was very dangerous for Hindenburg and Dankl. The Russians, giving up Przemysl that Ivangorod might be saved, had succeeded in accumulating numerically superior forces in the neighborhood of the latter town. Besides, Hindenburg's left flank was threatened with an encircling movement, risking the severance of the important line of communication Lowicz-Lodz-Kalisch. He had effected the advance on the Weichsel with only twelve infantry divisions. The center of gravity of the operations was at the San where the Austrian main forces under Archduke Fredrik, with Hoetzendorf as Chief of General Staff, were to execute the main attack. In this situation Hindenburg decided not to continue the fighting at Ivangorod and not to interfere with Dankl's left wing, but to advance on Warsaw with his own forces.

"Never was a more daring decision more daringly

EUROPEAN WAR—Continued

executed," says Stegemann. The blow was directed against the citadel and the center of strength of the enemy, the pillar of the Weichsel defense. The decision was not a trick of any anemic art of maneuver, but a firmly cemented, powerful blow." It was begun partly thru a half turn to the left and partly thru a flanking movement, brought with lightning rapidity into the concentration of Russian troops at Warsaw begun several days ago. The advance could not have as object the conquest of the latter town, but only aimed at the disturbance of the mentioned concentration and to prevent the Russians from crossing the Weichsel, thereby giving the Austrians time to break thru the San front and to attack the left flank of the Russian forces which were fighting with Dankl about the Weichsel crossings. The main object of the advance was thus an offensive to relieve pressure on another front and gain of time. Hindenburg's movement of attack—certain forces were left in front of the bridge heads at Ivangorod and Novo Alevandrija—was executed with an extraordinary rapidity and surprised the Russians before general Ruski had time to attack the German left flank with the forces north of and at Warsaw. Several Russian divisions were surprised and defeated, and the Germans pressed on to Warsaw, as if they intended to take it by storm. The Russian High Command supposed this to be a new German army which had advanced from the west via Lodz. It was thought impossible that Hindenburg could have left such a small force as two and one-half army corps at Augustow-Suwalki. Nobody suspected that thru forced marches from Radom he had thrown three whole army corps against Warsaw, while his other troops fought in connection with Dankl's army. The 13th October the attack had reached its climax, however; Scholtz, Mackensen and Frommel had covered themselves with glory. In the meantime, the Austro-Hungarian main forces in Galicia were fighting at the San and the Dneister. The numerical superiority of the Russians shortly made itself felt, and the two allies had to accept the defensive. They were fighting under very unfavorable circumstances. The roads were bad and their own railways were not yet reconstructed, while the Russians could use their strategical railway net (built with French money) between the Weichsel, the Narew and the Bug, with Lemberg as a splendid center of communication.

In the middle of October (15-17), the situation of the two allies was very serious. Thanks to numerical superiority and abundant reserves (more than two million bayonets) the Grand Duke Nicolai became the master of the situation. He held the Austrians in check in Galicia, while he distributed his forces from Warsaw over Nowogeorgiewsk to the northwest in order to, at the bend of the Weichsel, prepare the same fate for his enemy as that of Samsonow at Tannenberg. Oct 17 Hindenburg had to make a new decision.

This decision aimed at the retirement of the left wing (the attacking hitherto) to the Rawka River and there to establish a fortified field position, while the right wing should form an attacking group on the left flank of the Russians advancing over Warsaw against the Rawka position. The German right wing formed of the Guard Reserve and the 11th Corps had to be disengaged in front of Ivangorod and replaced by troops belonging to Dankl's army. This was successful. The last German divisions left Ivangorod for the new front during the night of Oct 21. One of the main conditions of the success of Hindenburg's plan was the necessity of the holding of the Austro-Hungarian front. In order to mislead the Russians, Dankl was to make an attack on Ivangorod.

Dankl's attack was successful to start with, but presently he encountered larger forces which threatened to flank him. Soon he saw himself involved in a battle which did not promise victory. Oct 24 Nikolai Nikolajewitsch on the front Skierniewice-Novo-Alexandrija (south of Ivangorod) attacked Hindenburg and Dankl, each with two armies, while a fifth one was directed via Novogeorgiewsk to attack the left flank and rear of Hindenburg. Two other armies were standing against the Austro-Hungarian armies in Galicia.

This numerical superiority made Hindenburg, in accord with Dankl, order a retreat Oct 26, Hindenberg behind the Warthe, Dankl behind the Nida. The former escaped being flanked, and at the same time protected Dankl's left flank. Some days later the Austro-Hungarian main forces were compelled to retreat from the San. Nov 1, Hindenburg became generalissimo of all the German forces on the east front. The Eighth German Army at Suwalki under General Francois was put under the command of General Otto Below, Francois being moved to the west front as chief of a reserve corps, and the troops behind the Warthe (Ninth Army) were put under Mackensen.

Hindenburg had not been strong enough to annihilate the enemy, but he had tried thru cleverly arranged and daringly executed offensives to paralyze the hostile forces and to lead them in other directions than those desired by the enemy, while showing his fidelity and strengthening the morale of the Austrians who had suffered so much during the retreat after the August offensive.

Eleven Russian armies were in field—nine in Poland and Galicia, and two in Caucasia ready to invade Armenia. Most of the armies operating in Europe were five corps strong, some of them even counted six to eight corps. This tremendous mass—representing more than 2,000,000 bayonets, 100,000 sabres or lances, and 7000 guns—moved forward in the beginning of November. It was on this occasion that the *Times* invented the catchword, "the Russian steam roller."

The Russian forces who started a general offensive in a westerly direction after the retreat of the two allies from the San and the Weichsel, were, largely seen, grouped thus: on the extreme right wing the Tenth Army under Rennenkampf which was formed of eight army corps and several reserve divisions; it had against itself, as before mentioned, General Below (Eighth German Army). In joint advance with the Tenth Russian Army the First Army (four army corps on the right bank of the Weichsel in the direction of Mlawa-Soldau and three army corps on the left bank against Thorn) were operating.

In the center General Ruski commanded four armies

(twenty-five army corps) with the task to advance against the Warthe and further in the direction of Posen.

On the left wing, General Ivanov with two armies—the third one was not fully organized yet—advanced against Dunajec and the Carpathian passes, Radko Dimitrieff was to lay siege to Przemysl. The reason for this grand offensive plan was the assumption that the German forces, which had fought in front of Ivangorod and Warsaw and at the Rawka, were very debilitated and that they would have to retreat to the west on account of the Russian flanking movement from the north; that Hindenburg could not expose Schlesien; and that his troops consequently ought to be encountered in a front position to protect this province. The Austrians were not considered able to operate in the open field.

Contrary to the scheme of the August offensive in the beginning of the war, which was a double flanking movement of attack, the Russian offensive during the first third of November was distinguished by a strong center grouped forward with the wings attached to it. The center of gravity of the enormous attacking movement was placed in the middle. Perhaps it was Hindenberg's offensive at Warsaw and the following retreat which was magnetically attracting the Russian main forces straight to the west.

The plan of operation of the two allies aimed at the distraction of the Russian offensive thru attacking the Russian main forces advancing in Poland. The Austro-Hungarian forces were to hold the Carpathian passes and the large gateway to Moravia and Silesia situated at Cracow and the district north of it, but they needed German reinforcements. To that end General Woyrsch with five German divisions was left on both sides of Czenstochau, and the Guard Reserve Corps and the Corps Frommel were dissolved. One of the divisions of the guard was removed to Thorn. Woyrsch formed "the resting pole" at Czenstochau in the big battle formation of the east front.

The Ninth Army under Mackensen was moved by rail during three days from Kreuzburg to Posen and Thorn and was grouped to the southwest of the latter point in a flanking position between the Weichsel and the Warthe, aiming at attacking the right wing and the flank of the Russian center (Moltke, Sr., fifty years ago, had drawn the attention to the importance of Thorn as a flanking position). Three divisions from the Eighth German Army and the 25th Reserve Corps under Scheffer-Boyadel were to move to Thorn; all that could be gotten together was concentrated at Thorn. Below on entering his command found his new army debilitated; with the remaining forces he should defend East Prussia and protect the extreme left flank. Cavalry divisions, already tested in war, arrived from the west front. Hindenburg established his headquarters in Posen. Mackensen had gone to Hohensalza (40-50 km. southwest of Thorn). On Nov 9 in the evening he received orders to attack the First Russian Army, which was advancing on both sides of the Weichsel with the task to maintain the lines of communication between the Tenth Russian Army and the large center group under Ruski.

The advance of Mackensen was executed with lightning-like rapidity in the main directions against Lodz and Lowicz with the 11th Corps on the left wing, the 17th and the 20th in the center, and the 1st and the 25th Reserve Corps on the left wing, which was the center of gravity of the advance. The cavalry in front concealed the movements.

In the engagements at Wloclawek and Lipno (about 50 km. southeast of Thorn) the First Russian Army was defeated. In the following battle at Kutno (100 km. southeast of Thorn) its defeat was completed (Nov 14-15). The right wing of Ruski (Second Army) was compelled, on account of this defeat, to interrupt its advance and fall back on Lodz, west of which the Russians were further defeated at the Bzura.

Hindenburg decided to continue the attack, and at the same time the Austro-Hungarian Army, Woyrsch included, was to attack from the Cracow-Warthe front. Thru Mackensen's continued attacks, the engagements which had begun west of Lodz grew to be a sanguinary battle. Nikolai Nikolajewitsch concentrated all available forces (Rennenkampf was called) against the focus of the operations, and on Nov 17 the Russians concentrated in the neighborhood of Lodz were numerically superior to Mackensen. While the First Reserve Corps at Lowicz insured the left flank, Mackensen attacked the northwest front of the Lodz position with three army corps and sent, under Scheffer-Boyadel, the 25th Reserve Corps and the Third Guard Division (Litzmann) north of Lodz via Brzeziny to attack the Russians in the rear, *i.e.*, from the east and southeast. Thru this movement the Second Russian Army was threatened with a Sedan. The Russians, however, were fighting with indomitable courage, knowing that reinforcements were on their way.

The 21st of November Lodz was surrounded from almost all sides. Litzmann then received the information that the Russians had taken Brzeziny where he had left a battalian. The line of retreat was thus cut off and Mackensen's encircling wing itself out-flanked. Also from the south Russian forces were reported to advance. The 25th Reserve Corps and the Third Guard Division seemed to be on the verge of destruction.

Scheffer-Boyadel called his division commanders together and asked Mackensen for liberty of action in order to save his troops. He got the wireless order to reunite himself with the Ninth Army via Brzeziny. The 22nd of November in the evening he started preparations to break thru. While the orders were issued, a chaotic struggle was raging on all sides: attacks against Lodz, defense against the south, east and north.

At 9:00 p.m. the movement started. It was executed in an easterly direction in five columns, one division in each column with the staffs of the divisions in front, Scheffer himself in the middle column. The direction was against the crossings of the Miazza (east of Lodz) which was crossed. During the 23rd the division had to fight the whole day against numerically superior enemies. In the evening the situation was such, that unless the breaking thru had succeeded within twenty-four hours, there would not be the slightest chance of salvation. Scheffer-Boyadel now decided to break thru during the night in spite of his troops being on the point of exhaustion. Then Litzmann dictated, in a railway

EUROPEAN WAR—Continued

section house, the following order: "The enemy is defeated, the division forms a march column and breaks thru to the north; the artillery and supplies remain under cover. Will receive commanders after the storming of Brzeziny on the square of the division headquarters on the 18th of November." 7:30 p.m. the order was issued, at five o'clock the following morning it was executed, and the headquarters of Litzmann reconquered. On the 24th of November at noon, Scheffer-Boyadel had grouped his troops at Brzeziny fronting the south, and on the 25th, bringing 16,000 prisoners and 63 captured guns, during constant engagements, he reunited with the Ninth Army. The Russians then advanced for a general counter attack. Mackensen fell back on the defense; the last period of the battle at Lodz was, however, not yet fought. Simultaneous with Mackensen's attack of Lodz, the Austrians and Woyrsch's divisions attacked from the line Cracow-Czenstochau; with varying luck and the enemy numerically too superior, they had to fall back on the defensive at the end of November.

The general Russian counter attack after breaking thru at Brzeziny especially pressed on Mackensen's left wing (first reserve corps). This received reinforcements, among others from East Russia, and thereby succeeded in holding the Russians back. But before the Russians succeeded in shaking the German front, Hindenburg was ready for new action. From the west front he received considerable reinforcements, namely, the Second Army Corps and strong parts of the 13th Army Corps (Pomeranians and Wurttembergers), relief troops, landsturm troops, heavy artillery, etc. Mackensen was thereby enabled not only to stop the Russians, but to direct a strong attack against the left (south) wing of the Lodz position. The battle at Lodz now entered its last phase; during the night of the 6th of December, the Russians evacuated their position, still holding Lowicz on their right wing, which point was captured by the first German Reserve Corps on the 15th of December, after being reinforced by Hindenburg.

Some days earlier, the long drawn out battle at Limanowa-Lapanowo in West Galicia had been decided in favor of the Austrians.

In the Middle of December the Russian troop masses were in general retreat from Lowicz west of Warsaw down to the Dukla Pass in the Carpathians; they had lost half a million men, of whom 130,000 were prisoners.

The grand Russian offensive was stopped and parried, the Russian army was shaken, but thoroly defeated. The Grand Duke Nikolai only yielded step by step, and he felt strong enough to make a halt in front (west) of the Weichsel and the San. The territory gained by the Germans after the battles at Lodz and Lowicz was 50 km. On the right wing, in the center about 33, and on the left wing only 20.

The Russian center adopted trench warfare during Jan and Feb, 1915. The Grand Duke being of the opinion that he could not gain any decision there, moved the center of gravity of his operations to Galicia, the Carpathians and Bukowina. The wings of the more than 1000 km. long front mainly attracted the attention during the first two months of the year 1915. The plan of the two Allies regarding the continuation of the operations on the east front in the beginning of 1915 is not fully known. Possibly it aimed at an attack of both wings, in the north as well as in the south. The right wing of the Allies attacked in the Carpathians, and several bitter battles were fought with success, yet without decisive results, in Bukowina, round Nadworna, at the passes of Uszok, Beskid, Lupkow and Dukla. Much more important was the activity of the left wing in East Prussia. During the beginning of the year the forces of Hindenburg (now General Field Marshal) were considerably increased. Behind the 8th Army the 10th Army was concentrated under Colonel General Eichorn, and besides an 11th Army was being formed under General Gallwitz in the neighborhood of Mlawa (east of Thorn at the railway line Danzig-Warsaw). Furthermore, a German south army under General Linsingen was organized and sent to the relief of the Austrians and put between the armies of Pflanzer-Baltin and Boroevic.

Since the middle of November, when Rennenkampf was ordered to Lodz, the command of the 10th Russian Army standing against East Prussia was given to General Sivers, who had vainly tried to defeat Below and thereby had extended his forces in a 170 km. wide circle from Tilsit in the north to Johannisburg in the south, exercising considerable pressure on Below's right wing.

Simultaneous with the railroad transportation of Linsingen's troops to the Carpathians, the 10th German Army was being pushed behind the left wing of the 8th Army, on the right wing of which Litzmann with a reserve corps and Lt. Gen. Falk with a mixed corps , were placed. Colonel General Eichorn's Army (10th Army) was formed of three corps and certain other units under the Generals Below, Marwitz and Lauenstein.

East Prussia, the Masurian Lakes and the woods round Suwalki, were at this time heavily covered with snow: The Russians did not expect an attack. Hindenburg grouped the 8th and 10th Armies for advance from the wings, on the extreme right Litzmann's corps, on the extreme left Fritz Below's. The aim was to surround the enemy completely. The 7th of February the order of attack was issued. The 21st the winter battle at the Masurian Lakes was concluded with the loss for the Russians of 165,000 men, of whom more than 100,000 were prisoners. A large gap had been made in the Russian front, but their Niemen and Narew fronts were still strong , and the iron will of the Grand Duke Nikolai was not yet broken.

At Tannenberg the surrounding of Samsonow was effected while both parties were advancing; Samsonow's army then marched into the danger. At the Masurian Lakes the surrounding had to be forced from a situation which to a certain extent resembled the fronts during trench warfare.

The strategic game between the Grand Duke Nikolai Nikolajewitsch and Hindenburg on the Polish scene of

operations during September, 1914, to February, 1915, might well be considered one of the most intensely interesting matches of strength which the war history knows.

The Grand Duke was of an iron nature. With tremendous energy he made all possible arrangements and no negligence can be laid to his charge. In view of his numerical superiority, it sometimes looked as if he was going to win the game. But Hindenburg was his superior. Surprise neutralized the inferiority of numbers, and he understood, in a masterly manner, the art of changing a line of operation, which, according to Napoleon I, may be considered one of the cleverest maneuvers which the art of war knows.

Another name ought not to be forgotten: that of Conrad von Hoetzendorf. He had to fight against tremendous odds as the real leader of the Austro-Hungarian forces, but the way in which he solved the difficult problems confronting him more than proves his firmness, daring, and resolution.

Rumania

[Rumania's War, 1916. By Col. K. Egli. *Schweiz. Monatschrift aller Waffen*, July, '17. 2100 words.]

The defense of Wallachia suffered a severe setback when, in the middle of November, forces under Kuhne broke thru the Vulcan Mountains. In vain the Rumanian First Army offered resistance at the Targu-Jiu position. Teuton troops attacked the position, and Schmettow's Cavalry Corps turned the position and cut the communications of the troops at Targu-Jiu and at Orsova by reaching Craiova. The way into western Wallachia was thus open for Falkenhayn's troops, and an opportunity was presented for Mackensen to cross the Danube. The junction of these armies would compel the Rumanians to retire to the line Bukarest-Ploesti, opening the Hermanstadt and Kronstadt Passes to other Teutons.

During the fighting on the northern boundary of Wallachia, Mackensen was attacked by Russians and Rumanians in the Dobrudja, and Rumanians crossed the Danube at Rahova. The Allies won some local successes, but Mackensen was not bluffed into withdrawing troops from Siebenburgen. From Oct 19 to 28 the Bulgarian, German, and Turkish troops in the Dobrudja moved forward, threw the Allies over the Constanza-Cernavoda line, and reached the Danube at Ostrov. In the face of Russian and Rumanian reinforcements Mackensen, early in November, withdrew a trifle. The Allies learned too late that this withdrawal was for the purpose of drawing more of their troops into the Dobrudja, and for sending Teuton troops to form the new Army of the Danube.

On Nov 23 the German cavalry, which had taken Craiova, reached the Alt, east of Caracalu. The infantry moved forward. On the night of the 22nd-23rd detachments of the Danube Army crossed at Sistovo and drove out the Rumanians. On the 24th the whole force was across, and moved against Alexandria. On the 26th the Vede was crossed. On the 27th the left wing was advancing on Draganesti, cavalry was engaged with the Rumanians near Slatina, Kuhne's troops had driven the Rumanians from the Alt, Krafft had reached Curtea de Arges, and the main body of the Ninth Army was near Campulung.

The Rumanians now assembled all available forces, and, in hope of preventing the junction of the Ninth and Danube Armies, launched an attack on the latter, leaving the First Army to hold the former. Rumanians, on the 30th, succeeded in turning the left of the Danube Army, while Russians made a strong attack on the right. Falkenhayn's Army was now placed under the command of Mackensen, and the former's right wing came to the assistance of the left of the Danube Army. The Rumanian attack had failed. Meanwhile Bulgarian forces defeated the Russians south of Bukarest. That city then fell without a blow. The Rumanian Army, which had been divided in two groups, the one at the foot of the mountains and the other on the Arges, was now split by the Teuton troops and hopelessly beaten.

The Rumanians now had to give up the Ploesti-Bukarest line, and retire into eastern Wallachia. They attempted a stand on the Arges, but in vain, as their forces were too depleted. Meanwhile the First Army, after attempting a stand on the Alt, was forced to surrender. The Russian offensive in southern Bukowina, at the end of November, had no effect on the situation in Walachia, and an attempted diversion in the Dobrudja was equally futile. By the end of January the latter district was clear of the Allies. Only unimportant operations ensued until July, 1917; at that time the reorganized Rumanian Army was enabled to take the field, but was unable to take the offensive when the Russians moved forward in Galicia.

The Rumanians made the mistake of giving up their neutrality because of land-greed. It will be years before they recover from their defeat.

[Rumanian Campaign, 1916-1917. By Maj. T. E. Compton. *Journal of the Royal United Service Institution*, Aug, '18. 12,000 words. 1 map.]

The entry of Rumania into the war in 1916 was one of the great events of that year. This, following the Allied successes of the Somme, Verdun, Gorizia, and in Galicia, gave great promise of an early decision to the Allies of a victory bearing the fruits they desired. The points of view of the Central Powers at this time is well expressed by Maximilian Harden in *Zukunft*, which was later suppressed because the Teutons were not ready to admit to their enemies that the true situation was so grave. At this time Harden wrote:

"It is no use pretending not to see the gravity of the situation for Germans, Austrians, Hungarians, Bulgarians, and Turks. It is the fight for our existence that is being played, and the play may end in tragedy. If the enemy can have his way, Bulgaria will be crushed, Hungary dismembered, Greece gained over, Turkey isolated, and Germany hunted down like a dangerous wild beast."

This is exactly what the Allies had in mind, and at Russia's invitation to extend the left flank of the Russian Army in Bessarabia, Rumania joined. But there were other influences which really won Rumania over to the Allied cause than as an aid to Russia, with

EUROPEAN WAR—Continued

whom relations had been anything but cordial. The reason for this unfriendliness was that by the Treaty of Paris (1856) Russia claimed Bessarabia which was inhabited principally by Rumanians, and gave in exchange only half of Dobrudja. This caused Rumania actually to fortify the line of the Sereth River against Russia to prevent further Russian encroachments. It was therefore due to other causes that Rumania consented to enter the war with the Allies. The first of these causes is a racial one: the Rumanians claim to be descended from the ancient Romans, a claim which seems to be justified; and the second reason, that Rumania has since the 18th century been influenced by French customs, and has depended on French literature for the intellectual progress of the nation, altho at this time Greeks from Constantinople were Princes of Wallachia and Moldavia. Napoleon III was also interested in this country, and it was after the Crimean War that these two states joined to form the present state of Rumania. It was therefore on this account that Rumania was more pro-French in her sympathy than she was zealous to aid Russia whom she mistrusted and who was to betray her again and again whenever an opportunity was presented.

As early as 1914 Rumania saw that she could not avoid being drawn into the war and set about to prepare. In this way the Rumanian Army had grown from 180,000 men in 1914, to 820,000 in 1916—when she entered the war with the Allies; 560,000 of these were combatant troops. The ripe moment for taking up arms was presented in the summer of 1916, after Brussilof's brilliant campaign which gave Russia Czernowitz and the whole of Bukowina. Rumania therefore declared war on Austria Aug 27, 1916.

The plan of campaign adopted divided the Rumanian forces into four armies: The First Army (Gen. Culcer), was the pivot of all the operations and was posted on the Jiul River based on Craiova; The Second Army (Gen. Averescu), was to support the right flank of the First Army and operate towards Brasso, based on Bucharest; The Third Army (Gen. Aslau), was to defend Dobrudja from Bulgarian encroachments from the south; and the Fourth Army (Gen. Presan), was to extend the line in Moldavia to connect with the Russians in Bessarabia, and to be based on Focsani. In all, the total forces aggregated 15 divisions, five detached cavalry brigades, one cavalry corps of two divisions, 20 regiments of light artillery, and 5 regiments of 4.2 howitzers.

By active co-operation between the First, Second and Fourth Armies, the initial successes of the Rumanians were of a most encouraging character. The First Army drove the Austrians as far as Hermanstadt where the latter were able to make a determined stand and be in touch with their base of supplies connected by an excellent railroad, whereas the Rumanians had no railroad and very difficult communicatoins. The Second and Fourth Armies pushed well into Transylvania and occupied a line running thru Magyaros-Sekekely-Kerecztu-Hendorf-Gross-Schenk-Fogaras. This was their farthest advance. Everything now depended upon a Russian offensive from the Bukovina which never materialized.

To check the victorious advance of the Rumanian Army and occupy the Russians so as to prevent their aid at this time, Gen. von Falkenhayn assembled the Ninth Army Corps consisting of 12 divisions on the lower Maros for a drive into Wallachia, while the Austrian Army under Gen. von Straussenberg concentrated on the Transylvania Plateau against the Fourth Rumanian Army for a drive into Moldavia. From the south the Bulgarians under Gen. Tosheff, and the Germans and Turks under Gen. von Mackensen planned to move from Bulgaria against the Third Army in the Dobrudja, which had only 3 divisions.

The first difficulty which presented itself to von Falkenhayn was the rugged and mountainous nature of the country in which he was to operate. To surmount this he had withdrawn from the Italian front a *corps d'élite* of Alpine troops, composed of Bavarians and Prussians. These troops added great mobility to his army, so von Falkenhayn placed them on the flanks of the army and advanced to turn the flanks of the Rumanians by forcing the passes thru which they had formerly advanced. In this the Germans were sucessful, and after driving the First Army back on Rumanian soil, von Falkenhayn left a masking force under Gen. von Staabs, while he turned the strength of his main army against the Second and Fourth Rumanian Armies on the Transylvania Plateau. By the same tactics here he was again successful, and after the occupation of the Rother Thurm Pass, the left of the Rumanian line on the Transylvania Plateau was turned and a general retreat necessitated. Gen. von Straussenberg with the Austrian Army was left to follow up the initial success of this maneuver, while Gen. von Falkenhayn turned his attention to operations in Wallachia with a view to a concentric move on Bucharest made in co-operation with von Mackensen who was operating in Dobrudja. In their retreat the Second Army retired into Wallachia, while the Fourth Army retreated into Moldavia.

In the meanhwile von Mackensen, after minor operations in conjunction with the Turks and Bulgarians, had secured control of the Rustchuk-Varna Railroad, and cut off any possibility of aid from the Ninth Division which was in Silistria. He next took Turtukai by assault, and then advanced against Silistria, which he occupied without opposition. Troops were rushed from Moldavia to reinforce the Rumanians in the Dobrudja, and even a Russian force was sent to help hold the line. Altho this is the first time that the Russians even went so far as to grant aid to the Rumanians, it proved to be their undoing, for whereas the Rumanians repulsed no fewer than five assaults of the forces under Gen. von Mackensen, the Russians were seized with a panic and fled, thus causing a general retirement from this defensive line. The battle was thus lost by the Russians, and the Teuton forces occupied Cernovada, Oct 25, 1916.

To secure his communications von Falkenhayn directed his efforts against Vulcan Pass, which after several reverses, he occupied Nov 15. Next came operations which should lead to a concentric move on

Bucharest, the Rumanian capital. Gen. von Mackensen after his victory at Cernovada had forced the passages of the Danube at Simnitza and placed a bridge across the river. He had also seized the giant bridge over the Danube at Cernovada. To cross was now an easy matter and he waited for the co-operation of von Falkenhayn's forces from the northwest to close upon Bucharest.

The Rumanian Army had taken up the position of the Arges for the defense of Bucharest. Due to Russian reinforcements which were contented to hold a fortified line along the Sereth River, all four of the Rumanian Armies were able to take their places along this line of the Arges. Two Russian Corps had also been sent to Bucharest to assist in the defense. A general offensive was planned for the Third and Fourth Armies facing von Kosch, who commanded the greater portion of von Mackensen's army, but the night before the attack two Rumanian staff officers with complete orders for the offensive, were captured by an enemy cavalry patrol, and with the element of surprise removed, the Teutonic forces were able to frustrate the attempts of the Rumanians. However, after a brilliant start in which von Kosch had to order a general retreat, due to the information he had received from the captured dispatches, von Falkenhayn directed von Schmettow's cavalry corps to attack the victorious Rumanians in flank. This caused a general panic and brought to a disastrous close a day that had opened with victory.

The Second Russian Army Corps offered no assistance, thus confirming the belief previously expressed that Russia would like to see Rumania beaten, and that her only object in sending forces into that theater of the war was to fortify a line along the Sereth River for her own protection in Bessarabia, in case Rumania was successful in the war, and demanded the restoration of Bessarabia, which to Rumania had for years been a problem similar to that of Alsace-Lorraine to France. Since the Revolution in Russia, documents have been published which show that Russia willfully and deliberately betrayed Rumania at this time in order to weaken or crush her and then prevent her from ever causing any trouble on the Russian frontier.

After this defeat on the Arges, the capital, Bucharest, was evacuated, and Gen. von Mackensen entered it Dec 12. The defeated and disorganized Rumanians in Wallachia retreated towards the line of the Sereth, while those armies in the Dobrudja which had to conform to the general retreat retired into Bessarabia, where the broad arms of the river and numerous lakes gave them protection against the armies of von Mackensen who advanced north and took Buzeu and Braila.

Endeavoring to retrieve their former disasters and regain their lost country, the Rumanians planned a brilliant campaign for July, 1917. In the spring they had been well munitioned by Russia, and had received supplies from all the Allies, including armored British motor cars, airplanes, and the latest types of artillery used on the western front. This offensive was to be carried out along a 50-mile front extending from the Oitoz valley to the Sereth, and was to be supported on both flanks by Russian contingents. Active operations commenced July 22, and were attended with the greatest success, 3000 prisoners and 32 guns were the booty of the first day of active fighting. The 218th and 117th German Divisions were routed and the road to Bucharest opened, when a telegram was received from the Russian Government ordering the Russian Fourth Army to proceed to Bukovina immediately. This change placed the Rumanians on the defensive and the Russians had for the second time betrayed them at a critical moment.

Counting all the forces which had been amassed by Gen. von Mackensen the Teuton forces now aggregated 24 divisions and 6 cavalry divisions. These vastly outnumbered the Rumanian Army, which in addition to its own troubles was now confronted with the chaotic conditions resulting from the Bolshevik régime which was to overthrow the military power of Russia. With Russia finally eliminated, there remained but one thing for Rumania to do: accept the best terms she could get and quit the war herself because of her helpless plight. However, the Allied nations refuse to recognize the validity of this enforced treaty of peace and it will be one of the questions for final settlement at the general peace conference when the Allies and Central Powers agree to a cessation of hostilities and a discussion of differences.

SOUTHERN THEATER

[The Tagliamento. By Hilaire Belloc. *Land and Water*, Nov 8, '17. 2200 words. 1 sketch.]

Crucially important as the Italian situation is, there is very little to say about it in the way of reasonable comment, first because it is still so tragically simple and secondly, because the irrformation at hand upon it is so meagre.

A summary of the military evidence available gives something like the following: The enemy concentrated a certain (unknown) number of extra divisions and a very great (but unknown) number of extra guns upon the northern part of the Isonzo front against the Second Italian Army, which held the line from north of Gorizia to the vicinity of Predil Pass. The concentration of the new divisions was made possible by the view the enemy now takes of the Russian front. The extra guns, which were decisive factors in the battle, must also have come from the Russian front where, in the enemy's judgment, they were no longer needed.

After a very heavy but short preliminary bombardment the attack was launched in the early morning of Oct 24, three blows being delivered by three picked bodies of two divisions each—exactly as at Verdun. All these divisions were German. The points of attack were, from south to north: (1) That launched from the bridgehead of St. Lucia, just south of Tolmino, which bridgehead the Austrians had consistently held thruout the recent operations.

(2) The second attack was opposite Caporetto in the very heart of the Isonzo Gorge, and was made with the object of establishing a bridge there, because Caporetto is the door to the only easy pass thru the mountains to the Italian Plain.

EUROPEAN WAR—Continued

(3) The third attack took place at Plezzo, which point was selected because it is the first place north of Caporetto where the plain is wide enough to afford room for the movement of troops.

The decisive attack was at St. Lucia. This attack cut off the Second Army from the Third and at once threatened Caporetto and made the crossing there possible, for the enemy moved northward from St. Lucia up the river. Caporetto was threatened from St. Lucia in the south and Plezzo in the north and a contemporaneous attack on it rushed the mouth of the pass.

By Oct 25 the center of the Italian Second Army was broken and the road from Caporetto via Vividale to Udine was open to the enemy.

The rupture of the Second Army involved the immediate retreat of the Third Army which fell back some 20 or 30 miles to the line of the Tagliamento, losing about 500 guns and 60,000 men. By the fifth day the remnant of the Second Army and the bulk of the Third Army had reformed a line behind the Tagliamento, and reinforcements were coming up from the rear. The enemy claims to have captured 1800 guns and 200,000 men.

The Tagliamento is an insufficient military obstacle and its line can easily be turned from the north. If the Tagliamento line be lost there is no really good short and strong natural line to hold until the Adige is reached—but the line of the Adige uncovers Venice. The line of the Piave is lengthy and unsuitable. Trenches can be dug anywhere but so far as natural obstructions are concerned, the Piave is a bad line.

[The Line of the Piave. By Hilaire Belloc. *Land and Water,* Nov 15, '17. 1800 words. 1 sketch.]

The Piave is a stream rising as a mountain torrent in the Dolomites. It flows thru a narrow gorge to the point called the Bridge of the Alps just above Belluno. Apart from the fact that the river as an obstacle is insignificant, the length of the mountain part of the valley (about 40 miles) forbids any attempt to use it by a diminished army. It has, as a fact, been abandoned. In withdrawing from it part of a division was cut off, with a loss of 10,000 men. The upper part of the Piave valley therefore forms no part of the Piave line.

Between Belluno and Nervesa the river makes a wide bend to the westward, greatly increasing the line that the defense would have to hold. At Nervesa the river enters the plains and it is here that the true line of the Piave begins. It is not know exactly to what point in the ligh mountains the line is continued from Nervesa but the shortest line would use a portion of the Piave above this point to near Vidor in the foothills, holding the heights which form the northern watershed of the Brenta or Val Sugana, thence crossing the gorge of the Brenta to join with the existing line on the Plateau of Asiago.

The length of the line in the uncovered open country between Nervesa and St. Dona, where the sea marshes begin, is but 25 miles, excluding the small loops of the river. The width of the Venetian Plain between Nervesa and the lagoons of the coast is at its least. There is a sort of waist here between the Friulian district on the east and the great plain of Padua and Vicenza on the west.

The line, then, on which the Italian Higher Command has decided to stake so much is briefly one of three sections. The true obstacle of the river between St. Dona and a point just below the Piave bridges; the indifferent obstacle between the latter point and Vidor; the mountain sector from above Vidor to the existing line on the Asiago Plateau. Such is the line of the Piave with its strength and weakness.

It has the military advantage that it is short, the political advantage that it covers Venice and the great towns of the neighboring mainland. The disadvantages are that the obstacle is very imperfect, that on the left flank and behind it is the threatened Asiago Plateau, and that if it be abandoned all further retirement rapidly extends the trace to be held by the withdrawing armies.

[The Second Italian Winter Campaign. December, 1916, to March, 1917. *Jour. Military Service Inst., U. S.,* Nov-Dec, '17. 6000 words.]

The organization and the supply services of the Italian Army gained a great deal by the experience of the preceding winter campaign. This was counterbalanced, however, by the increased difficulties due to the larger size of the army, to the more complicated development of its technical departments and to the severe weather experienced during this winter.

The defensive works were based on the following principles: The first line should be as mobile as possible in order to succeed by sudden and small actions, in rectifying and improving the front, fostering the offensive spirit of the troops. Behind this line there should be several successive lines of trenches, reinforced by strong points and redoubts, forming together a deep and reliable barrier against enemy attacks as well as a good base for further offensives. The artillery and trench mortars should be distributed in such a way as to assure, by the proper siting of dug-outs observation posts, etc., prompt and effective action. Finally, a good system of numerous communication trenches should be established permitting of relative safe movement thru the lines.

An enormous amount of labor was required to complete this work and it was nearly all accomplished on mountains and rocky ground where the aid of machinery was absolutely necessary. Frequent and heavy snow-falls filled the entrenchments and buried the wire entanglements, compelling them to construct temporary entanglements and sometimes to rectify portions of the front in order to avoid possible avalanches.

The accommodations for troops were constructed on the principle that comfort should gradually replace safety as one got further away from the firing line. The uncovered trenches were provided with weatherproof shelters, while further back the supports were sheltered in caves or in bomb-proof dug-outs, the reserves being in wood or concrete buildings.

The railway service was brought to a maximum never before obtained and the transport of fire wood, building materials, ammunition, horses, and troops going on leave, were successfully accomplished. Numerous new sidings were built, track laid, switches established and stations enlarged. Numerous canals were widened and deepened, new canals built and navigation possibilities on certain rivers improved.

The employment of motor lorries was very general, they were provided with non-skid devices, with special insulating covers, to prevent water from freezing, and with oilcloth aprons for the protection of drivers. When vehicles could not be used, transport was effected by pack animals and sledges.

A special service was organized for clearing the roads of snow, roads for motor traffic being kept entirely clean while roads for sledge traffic were left with a convenient layer of snow.

The food supplies service had to overcome greater difficulties due to the foregoing hindrances, and to the increased requirements of troops. They were met by establishing advanced supply bases at the extreme limit of motor traffic. The transport from these bases to the lines was effected by pack animals, sledges or aerial cable ways.

One of the most important elements of success in modern warfare is the perfect knowledge of the complex organization needed, of the intricate mechanism of its working, and especially of its technical requirements. The proper training of the troops is therefore of the utmost importance. To this end numerous training centers were established and the troops, while resting, were practiced in defensive and offensive warfare, in fortification works, in rifle and machine gun shooting, and in the use of different defensive and offensive weapons.

Altho weather conditions and the mountainous nature of the front did not allow during the winter any operations on a large scale, the activity of the Italian troops was not entirely arrested. On the Trentino front operations of considerable importance took place at the head of the S. Pellegrin Valley. The Italians occupied an enemy position there on Mar 4, but it was retaken on Mar 17. Further north were many instances of mine warfare.

On the Juliana front the milder climate allowed considerably greater activity, slight advances being made during January and February. In February, the enemy attempted to regain their lost ground but without permanent success.

On the Carso the Italian line was advanced at various points during the early part of January. On Jan 8, the enemy carried out a violent bombardment of this line but with no success.

On the Albanian front no event of importance took place. Italian troops occupied some small portions of territory in the mountainous area between the upper Ogussa and the Ossun, in order to establish contact with the French lines.

On the Macedonian front Italian troops were transferred from the Bab Mountains to the area of Czerna. On Feb 12, enemy troops attacked Hill 1050, east of Paralovo, and succeeded in occupying a portion of the trenches. The ground was regained on the following day and the counterattack repulsed.

On Feb 27, by a sudden attack, Italian infantry occupied the portion of the entrenchment on Hill 1050 which had been held by the enemy.

[The Italian Front. Calling Up of the German Class of 1920. By Hilaire Belloc. *Land and Water,* Nov 22, '17. 2800 words. 4 sketches.]

Before touching upon the resistance upon the Italian line of the Piave, attention is invited to the most important piece of news that has been received since last summer. It was official, and its full meaning is thoroly understood by those who sent it out—The Germans have called up Class 1920. The meaning of this fundamental piece of news summed up is as follows:

(1) The French have not yet called up any of class 1918.

(2) Germany called up 1918 exactly this time last year, and the fighting—mainly the fighting in Flanders—has eaten up not only 1918 but already so large a part of 1919 that she is now compelled to call up 1920.

(3) Class 1920 means the lads who are not yet 18. The oldest of them will only be 18 on the 1st of January, and the youngest of them *is not* 17.

(4) The German Empire has for the first time since the war began been compelled to call up three classes in exactly one year. When she called up 1918 a year ago she was two years ahead of the normal. She is now four years ahead.

* * * * * *

The Italian front consisted—when the enemy's present maneuver began ten days ago—essentially of two limbs. One limb ran along the Piave from just north of Quero to the sea. The other limb ran westward from Quero north of the wall which the foothills of the Alps make as they fall sharply upon the Italian Plain.

The defense upon the Piave is concerned with the maintenance of an obstacle while reinforcements come up, and politically as well as strategically with the covering of Venice. The loss of Venice would be a political blow of the gravest character and strategically would mean the loss of any power to act upon the northern and central Adriatic.

The sector in the mountains, however, is the more important strategically, for if this sector be forced, not only is the line of the Piave turned, but no very rapid retirement from it will be possible.

A glance at the map will show that the coming down of the enemy over the mountain wall west of the Piave would mean his immediate appearance upon the main railway lines on the northern Italian Plain, which are the vital communications of the army on the Piave. If the enemy can cut these lines it means a complete disaster to the forces now upon the Piave's banks. The enemy is now rapidly concentrating

EUROPEAN WAR—Continued

against the mountain or Asiago sector, but he is handicapped by the nature of the ground. The season is far advanced for operating in the mountains.

With reference to the Piave sector, it must be remembered that if the enemy has any hope of getting thru in the mountains it is to his advantage that the Italian line on the Piave should not break. It is to his advantage to hold as many Italian troops there as possible by menacing the river crossings. Everything now depends upon the power of the Allies to hold what is left of the mountain sector securely. The essential thing for the enemy is to master the heights on both sides of the Brenta valley above Bassano. His only other policy is to elbow the line back from the Piave and weaken it at the junction of the mountains and the river. But that would not give him such decisive results as would a success on the Brenta bringing him down to Bassano. It is at this point that the chief danger lies.

[The Taking of Mont Tomba—From a Frenchman's War Diary. *L'illustration,* Jan 26, '18. 2600 words. Lanscape map.]

(The article gives a very good description of the country around Mont Tomba, and a discussion of the strategic importance of its possession.

The preparation for the attack by the Chasseurs Alpins is discussed and described chronologically beginning on the 20th of December, and ending on the 29th. The attack on Dec 30 is described chronologically by hours and minutes from midnight until 16 hrs. 5 m., the hour for the attack.

This is followed by a discussion of the Austrian retreat to the north of the Ornic; the number of prisoners and amount of war booty captured, and the general results achieved.

The author recounts many incidents of interest which occurred during the battle.

The Chasseurs of Dilleman's Division bore the brunt of the attack, assisted by Italian bombers, who did excellently, and by Italian, French and English artillery.

The capture of Mont Tomba was, tactically, very disadvantageous for the Austrians.)

[The Theater of Operations of the Italian Army. By Lt.-Col. A. Fonjallaz. *Revue Militaire Suisse,* Sept, '17. 2100 words. 1 map.]

On July 9 the following was stated to be the official and fundamental idea as to operations: "To first engage the enemy on the whole front from Tolmino to the sea by an intense artillery fire which would leave uncertain the true dirction of the decisive attacks. Then to assail his right flank north of Gorizia, followed by driving home a violent blow on the Carso."

The success of the Italians in their task, faced as they were by an immensely difficult terrain, is unquestioned. The Austrian counter-offensive did not obtain the results desired by them. The Italians took by assault the crest of the Cucco and the approaches

(Then follows a narration of the operations of the Italians in the Spring of 1917.)

[The Theater of Operations of the Italian Army. By Lt.-Col. A. Fonjallaz. *Revue Militaire Suisse,* Dec, '17. 2000 words. 1 map.]

The preliminary actions of 1915 were merely training for the Italian Army in modern warfare, both on the plains and in the mountains.

In 1916 the Austrian offensive on the Trentino followed by the vigorous Italian counterattack on the Isonzo was the occasion of many hard-earned lessons. The Italians had the river southwest of Gorizia on the 8th of August. In the autumn the activities in the Alps began, first on the Pasubio, then on the Carso.

In the spring of 1917 the operations extended to the north of Gorizia, and reached their zenith with the capture of Mont Cucco-Vodice and the attack on the advanced positions of the Hermada.

The last Italian offensive began on the morning of Aug 19, after an intense 24-hour bombardment along the 60 km. front from Plava to the sea.

The situation of the combatants was greatly influenced by the difficulties of the terrain. The country is a succession of obstacles—mountains, plains, rivers exposed to fire, rocky, lacking in water and in lines of communication, and rendered even more impassable by artificial defenses accumulated during two years.

Tho the general front of attack was known, more or less exactly, by the Austrians, the exact zone of the decisive attack was very difficult to locate. It could have been in the direction of Hermada, in that of Selo, or in the region northeast of Gorizia.

In launching the offensive as they did, the Italians showed that it had been minutely prepared, that it was properly backed up with men and matériel, and that they were determined to make a big, impressive gain.

The attack was characterized by such difficulties as the passage of a swift river, the consolidation of an unknown region to a safe depth beyond this river, the preparation of great quantities of technical matériel such as telephones, telegraphs, auto transportation, bridges, and railroads. All this, besides the preparation of a plentiful supply of rations, forage and drinking water.

The Bainsizza plateau has the characteristics of both mountain and flat countries. The Carso forms the southern pillar for the defense of Gorizia; Mt. San Gabriele forms the northern pillar.

Mt. St. Gabriele presents all the characteristics of a powerful defensive zone closed on all fronts. Four long lines spread out like a fan from its highest point, which is 646 m. high, forming four practically symmetrical buttresses, which add singularly to its defensive strength.

These four buttresses may be located as follows:

1. Southeast. The San Daniele-Zoerenz line parallel to the Ravnizza-Ternova route.
2. The southwest line on Tivoli, east of Gorizia.

to the Hermada, both important for future operations.

3. To the north, the line on Veliki Hrib to the Britof crossroads.

4. To the northeast direction on Pavnizza, close to the Ternova region.

One immediately notices the importance of San Gabriele as a central point of the bastion northeast of Gorizia; the loss of this mountain would make the whole defensive plan of Gorizia useless.

All the positions mentioned had been put in a state of defense according to the latest ideas. For many months the Austrians had been accumulating defenses, and constructing lines of trenches less than 100 yards apart. Thus, the capture of one of the positions would only be a preliminary success, which would merely prepare a way for the capture of the ensemble.

In front of the first lines the Austrians had constructed a line of very strong, small posts. The destruction of these posts by artillery was necessary before the attack proper could even be thought of. Innumerable machine guns were placed so as to give a cross fire over the entire region. These were so well placed that their complete destruction before the attack was impossible.

Further to the north, the Bainsizza plateau broadly resembles the Carso. To the west is the Isonzo River, where the Austrians were intrenched, at a short distance from their adversary, along the left bank of the river. The Austrians occupied the Auzza-Britof line, supported on the right from the Fratta district, covered to the front by the river and its steep banks, and with their left flank covered by the defenses of Descla. This first line was naturally covered by the line of mountains, Semmer-Verh-Cucco (711)-Jelenik.

Between Mounts Jelenik and Kobilek there was another line of trenches uniting these two high points, and with the town of Madoni, admirably completing the defensive strength of the region.

To the east of the plateau there is the long, broad valley of Chiapovano, and to the north, the small Avscek River, which runs towards Auzza; these two valleys encircle the region around to the Isonzo River.

Before the offensive of the month of May we saw a part of this defensive system between the Plava and Mont Santo captured by the Italians, and the remark was made that the capture was the forerunner of a great operation.

At that time, the Italians realized that it was necessary to withhold reports as long as possible, as the Bainsizza plateau had to be captured before the attack on Mts. Santo and Gabriele was taken up. As before mentioned, the operations consisted in passing a swift river and in capturing a mountainous bastion, defended even to its most remote corners by all the methods of modern technique.

The crossing of the river north of Anhovo will always be one of the greatest acts of Italian bravery. The Italian communiques commented very soberly upon this deed.

Between Anhovo and Auzza the Isonzo River runs between mountains, like a moat between high walls. It had already been crossed in May, 1917, at Bodrez by the Bersaglieri; but this passage was of no importance except to show the Austrians what the Italians could do.

The Austrian defenses ran the full length of the river. Further away from the bank the Austrians had constructed redoubts in the woods, which were connected with the river defenses by communication trenches. All the ground was well patrolled and by night it was lit up by searchlights.

The Italian artillery, especially the bombarding artillery, delivered its destructive fire while the Italian pontoniers carried their first subdivisions of the "arditi" into place during the night. The bridge construction then began, and shortly afterwards the first battalions passed over to the other side of the river and gained a footing. The first phase of the attack, which was marvelously organized, succeeded and opened the road for the offensive. Thanks to the dispositions of troops, etc., which had been minutely worked out, the offensive was a success.

In the offensive the Italians had to move over a rough country without lines of communication where the artillery would have to move very slowly. Moreover good water is only found at a few places on the Bainsizza plateau, such as Bate, Lahka, and Ravne, which are all near main roads. It was necessary to assure food, water, and munitions for the troops until these places were captured.

The Austrian resistance was very determined. Between Bodrez and Loga the Italians suffered very heavy losses. Officers leading troops fell one after another. South of Bodrez the crossing was a series of successes and reverses, ending with the Italians victorious; this was also the case near Anhovo. All the fourteen bridges that had been contemplated were successfully completed, and fourteen columns started across the river, those on the left marching on Semma-Fratta, while those on the right marched on Mt. Jelenik.

On the evening of the 19th the Italians did not yet have the situation thoroly in hand as the enemy had not yet been driven from Mt. Jelenik. On the 20th success was assured to the north, near Fratta. The Italian artillery intensified its fire to the northeast and stopped all Austrian attempts at a counter-offensive, while the Italian attacking columns, turning to the right, marched southward onto the plateau of Verh, engaged in skirmishes around the defenses of Mt. Jelenik and isolated Mt. Santo, which had to surrender.

All the Bainsizza plateau fell as a result of this enveloping movement of the left wing of the Second Field Army. But its full effects could not be realized unless the Second Army co-operated actively with the Third Army further to the south. This co-operation was gained and the Italians entered the enemy positions to such an extent that they were well situated for further offensives.

The capture of this plateau constituted a success of the first magnitude; all the more so, since it absolutely

EUROPEAN WAR—Continued

broke up all communication between Mounts Tolmino and San Marco.

The Third Army resolutely supported the Second Army by attacking the region of the Hermada and Gorizia. Hard fought combats, by which the Italians rectified their lines, placed them near Raccogliano, north of Castagnevizza, by Sept 1. To the south, their line passed Selo and extended westward to Flondar. On the same date the most advanced line on the Bainsizza plateau was along these localities: Mesniak-Kal-summit of Volnik-Zagorje, and east to Salcano.

The Italian victory was not decisive; it was only one stage in the offensive march, but, considering all that had been done up to that time, it was a most important stage.

The Austrians lost the advantage of being able to attack on the Carso as soon as their right flank became exposed. They lost a strong supporting point for future maneuvers, and outside of their losses in men, matériel, and territory, their morale received a serious blow.

The Austrians could re-establish the equilibrium only by a counter-offensive along their entire front, in which all their forces would have to take part. The Italians on the other hand were high spirited and were in a position to push the enemy clear out of the broken country, where surprises were always possible.

Mountainous terrain has the characteristics of being extremely strong everywhere and of always having one point where the defenses can be pierced with sufficient men. If this break could be made behind the positions where reserves were massed, it might bring a complete evacuation. The Bainsizza plateau is naturally strong in the direction of Carso, but much less so to the north around Mont Caporetto.

[The Germano-Italian Campaign. By A. *Memorial de Caballería*, Dec, '17. 3000 words.]

The month of October closed with the Germans inflicting terrible punishment on the Italians on the Tagliamento. The Italian cavalry covered the retreat of the infantry in an admirable manner.

The feat of arms executed by the Italian cavalry has seldom been equaled in the history of war. The Genoa regiments practically sacrificed themselves in the face of machine gun fire in order to save their retreating comrades.

Nevertheless the cavalry was sacrificed. The Italian commander had enough cavalry to protect both his second and third armies in their retreat, without the cavalry being entirely annihilated. The trouble was that Gen. Cadorna did not have any of the complementary cavalry services which are so necessary to the modern mounted soldier. Consequently, the cavalry loss was productive of less good than it should have been and is a reflection on the general state of the entire Italian army.

The defeat on the Tagliamento was a hard blow to the already unnerved Italians. The river line was forced simultaneously at Genoa, Dignano, Codroipo, Ratisana. On Nov 6, the Austro-Germans occupied Livenza and on the 9th they reached the Piave. This advance was made by forced marches along the plains, but more slowly in the Carnic Alps and the Cadora forests.

Once the abandonment of the Isonzo line had been decided upon, and the withdrawal to the Tagliamento line taken up, there was no reason for the Italian troops along the northern frontier remaining in position and exposing themselves to an attack from the rear. When he ordered the third army to withdraw Cadorna also ordered the immediate evacuation of the Carnic Alps. But these troops had a long and difficult march before reaching the Piave, and with the fall of the fortress of San Simeon, which commands the great bend of the Piave at the mouth of the Fella river, their retreat was cut off. Part of the third army disbanded; part of it was captured. The fall of the Carintia front followed that of the Cadora sector. The troops in this latter sector did not receive the withdrawal order until after the others had moved. This was probably because Cadorna counted on halting the retreat on the upper Tagliamento or on the Livenza. The fact is that the entire Italian line from Plezzo to Valsugana in the Trentino went to pieces quickly under the overwhelming Austro-Hungarian advance on the plains and under the pressure of German divisions which had been on the frontier for quite a while.

The Italian retreat in the first part of November was not different from any other big retreat in the history of war. Strategically the maneuver was simplicity itself. The Austro-Hungarian armies of the center and left, and the left army on the German right wing marched along the plains without halting for any rest whatever until the Piave had been reached. The right flank of this advancing mass was protected by von Below's Germans and by Austro-Hungarian Alpine troops. These occupied the mouths of the box-like valleys which descend from the Alps and gave the Italian frontier troops the final crushing blow. At the same time the Imperial troops from Carnia, Cadora and Cordevelo took up the offensive and formed on the north and west, the center, and the other jaw of a powerful crusher which closed on the 10th south of Beluno. With this the old Austro-Hungarian front was cut down to a fourth its former length. On the 11th the battle was extended to the Val Sugana where the first forces of Gen. von Conrad appeared in the Trentino, and Fettre was captured. On the 12th other masses appeared on the Setti Comuni plateau and Asiago was taken which allowed the juncture of the Trentino army and Archduke Eugene's forces by way of Primolano. Austro-Hungarians crossed the lower Piave but the Italians cut the dikes between the two sources and forced the Austrians to withdraw to the left bank.

Before the second and third armies had concluded the passage of the Tagliamento Gen. Cadorna had ordered the fouth army to cover the Piave line, and the first army to establish iself in the mountainous region between this river and the Brenta, supporting themselves on the forts and trench systems which had been carefully prepared ever since the Austro-Hungarian offensive of 1916. It is probable that Cadorna's original plan was to use the Piave line to cover an

orderly withdrawal to the Adige river, or perhaps to the Mincio, but the arrival of Anglo-French reinforcements and the paralyzation of the German offensive made the Piave a permanent line of defense, for which purpose it is not very strong.

In the first days of November allied troops from France and England reached Italy. They garrisoned the principal cities of the north of Italy where a popular movement was feared and the remainder took up a position on a new front. It was either on the Mincio or the Adige and the allied troops were entrusted with the left flank of the new position in case of a withdrawal from the Piave. The exact position of the allied forces was kept secret, but they were in a position to prevent any invasion of Lombardy.

The possession of the Piave line depends entirely upon the possession of Monte Grappa, between Valdobiadene and Valstagno. Once the Austrians take Monte Grappa with its eastern and western spurs and the entire Piave line is taken in reverse.

[The Theatre of Operations of the Italian Army. By Col. A. Fonjallez. *Revue Militaire Suisse*, Feb, '18. 2400 words. 1 map.]

It is too soon to fix the causes which determined in a few days the Italian retreat. The Austrians had found it impossible to stop their advances alone. After the victories of the Bainsizza many critics demanded the intervention of powerful forces in Italy. The importance of this front was becoming always more appreciable, for the repeated successes of the Italians must sooner or later provoke a reaction by the Central Empires. But victory enfeebled the Italians without attaining that end of all victory—the exhaustion of the enemy. Cadorna had a double task: to direct operations and to restrain the moves of the opponents of the war; a war considered by Italian patriots as a national work terminating the enterprise of fifty years ago. The anti-war party was very powerful, however, and had no small part in producing the situation we find to-day.

The principal lines of operations of an Austro-German offensive must converge on Italian soil. They must lean as long as possible on the railroads, and must never rise to altitudes which would render their utilization problematical at certain seasons. Operations by the Stelvio,' the Touale, the Judicaries, and the Adige form a divergent sheaf, the points of issue of which in Lombardy are easy to defend. The Valteline, Brescia, and Verone are also points of support which would stop without trouble columns engaged in the mountains. Other means of attack could be classed as two sheafs, one leading on Padua and the other on Udine. The first is largely in the mountains with no railroads. The second is more favorable, being the shortest route from Austria to Venitia, and having a direct railroad. It follows that a drive launched on the upper Tagliamento must fall in case of success on the Carso front, and troops massed to the north of Gorizia would have little chance of escape. Deprived of roads in sufficient numbers and encircled in rear by the Isonzo, they would have no strong point behind which they could take up the defensive or re-establish their equilibrium. The Tago is an excellent cover for the left flank of the Italians because of its hilly terrain. In the operations of the present hour the Tyrol must be considered . Its configuration is admirable for defense. It presents successive concentric lines of defense against the south. A few fortifications could arrest any offensive from the south and gain the time indispensable in any maneuvers on a grand scale. A surprise is therefore impossible.

The first line of communication toward the east between the Tyrol and the Cadore is that of Mount Croce, toward the east the great highway of Landro which leads directly to Cortina D'Ampezzo and from there to Pieve di Cadre and Bellundo. The offensive which got these two roads would render itself not only mistress of Cadore, but also of one of the outlets on the Conegliano-Bassano front where the routes converge on Trevise and Padua. If afterward this offensive could unite with that flowing out of the Voi Sugana, it would possess a line of the very highest importance. The line of the Adige from Rovereto to Castelnuovo forms a long defile narrowed at the east by the Lessini Mountains, and at the west by the river Baldo and Lake Garda. This terrain is rich in defense positions because the Adige has few means of passage. The plateau of Rivoli is the last sentinel on the means of access by the Adige to Verona and Mantua.

The line of the Stelvio is easy for the Austrians to hold. They hold the heights to the north and south of the saddle and thus have all the advantage on their side here. From these studies of the different lines of operations it appears that difficulties go in an ascending scale from east to west. The vulnerable parts of the Italian line are in the east, while along our (Swiss) frontier and in the Trentini mountain obstacles will long arrest an Austro-German invasion.

[The Battle of the Isonzo. Ruiz de Valdivia. *La Guerra y Su Preparación*, Mar. '18. 100 words; 26 photographs.]

This is an excellent photographic description of the Italian retreat from the Isonzo. The photographs were all taken by Austrians immediately after the Italian withdrawal and show very clearly the haste with which the Italians withdrew and the vast extent of material which was captured. One interesting picture shows a German army commander and his staff in the field observing the progress of the battle.

[The War-Situation Feb. 1st, 1918. By A. *Memorial de Caballería*, Jan, '18. 400 words.]

Italian Front

On Dec 24 Austro-Hungarian forces captured the Col Di Rosso (1726 meters) on the Asiago plateau. By this capture the Austro-Hungarians command the Val Freuzela from the south. They are gradually approaching the town af Valstagna where the Freuzela empties into the Brenta. A single push would have allowed the Austrians to debouch into the plains and break the Piave line absolutely, as the Italian positions were all on the last mountain chain which was much easier to approach than the other positions from which they had been driven.

EUROPEAN WAR—Continued

With the conquest of Col Di Rosso, however, the Austrian offensive halted and a few days later the Italian counter-offensive started. It began in January with French attacks on the north flanks of Monto Tomba and the Austrians had to abandon their front line position. Later the French advanced to the west of Monte Tomba but were thrown back. On Jan 27 the battle extended to the Asiago plateau with the Col Di Rosso as objective, and on the 30th the Austrians were driven out with a loss of 2500 men and 6 guns, having captured some 700 men themselves. No German troops were with the Austrians, and no counter-offensive was undertaken.

From the time the Italian designs on Col Di Rosso were known until the mountain was captured, the Austrians received no reinforcements tho it was a period of three days. This is significant, and indicates that the main part of Marshal von Conrad's forces have been moved away from the Asiago plateau, and that the Central Powers have decided not to undertake a further offensive in Italy for the present. In fact this idea may have been abandoned altogether. This presumption is corroborated by the fact that the Austrians evacuated the bridge head of Zenzon on the right bank of the lower Piave.

The present conditions are certainly not the best for active operations because the Austrian lines of communication are constantly being interrupted. The rest which the Italians have had has greatly reduced the moral effect of the Tagliamento and Isonzo disasters. This moral factor was of prime importance to the Central empires.

The cessation of activity in Italy when the Central empires were so close to a decisive victory is merely an indication of the fact that von Hindenburg has decided to begin operations in another theater—and as there are only two fronts left, it is either the French or the Macedonian front which will see the scene of the next offensive.

SOUTHWESTERN THEATER

The Dardanelles

See also
DARDANELLES, OPERATION AT THE (1915)

Macedonia

[Venizelos and His Army. By Lewis Freeman. *Land and Water*, Nov 22, '17. 3000 words.]

The Venizelists have had a bad time of it from the first but the blackest hours of all were those in April, 1917, when King Constantine was still strong in Athens and before the Allies at Salonika had found it practicable or expedient to welcome them to a full brotherhood of arms. From an interview with M. Venizelos at this time it was learned that the problem uppermost in his mind was that of wiping out the score of the Allies against his country by giving them a substantial measure of assistance in the field. His military forces then consisted of three divisions, one of which was in the trenches.

The Serbian and two or three other armies have been worse off materially, but no national force since the outbreak of the war has been in so thoroly an unenviable a position on every other score as was the Venizelos Army at this time. The Serbs and the Belgians had at least the knowledge that the confidence and sympathy of the Allies were theirs. Also they had chances to fight to their hearts' content. The Venizelists had scant measure of sympathy, and still less of confidence, and when their first chance to fight was at last given them, they were only allowed to face the foe after the most elaborate precautions had been taken against everything from incompetence and cowardice on their part to open treachery. That this was the fault neither of themselves nor of the Allies, and had only come about thru the perfidy of the King to whom they no longer swore fealty, did not make the shame of it any easier to bear for an army of spirited volunteers who had risked all for a chance to wipe out the dishonor of their country. It is said that Greek divisions proved their value as first class units under fire and in fact were the only contingent to take all the objectives set for them during the spring offensive on the front from Lake Doiran to Albania.

[Salonika and the War in the East. By Commandant René Pinon. *Military Historian and Economist*, Apr, '18. 4000 words.]

The only natural outlet from the valley of the Danube to the Mediterranean is thru the valley of the Morava and its continuation south by the valley of the Vardar. It is the historic line followed at all epochs, leaving the Danube at Belgrade, and ending at Salonika. Salonika is therefore of high political and economic importance as the débouché of the shortest line between Germany and Austria and the Suez Canal.

(The author concludes that the control of Salonika and the Balkans would make Germany mistress of Europe in ten years, and that therefore the Germans must be conquered and that a stable order must be created in the peninsula to the exclusion of German influence. The military topography of Serbia and Macedonia and the military operations by which the Serbian army was driven southward are given in good general outline. The allied troops took possession of Salonika. Offensive operations were inaugurated in August and September, 1916, but the difficulties of terrain and the unhealthful conditions stopped them. Since 1916 only minor operations have occurred, and the part played by the army has been passive, tho important.)

Palestine

[Palestine. By Hilaire Belloc. *Land and Water*, Nov 22, '17. 900 words. 1 sketch.]

On Nov 13 the enemy lost the positions along the Wadi Sukereir and fell back five miles to the Wadi-es-Sukar, covering Jaffa. Over 1500 prisoners, 20 machine guns and 4 field pieces were taken during that day's advance.

On Nov 14 the junction of the North and South railway and the Jaffa-Jerusalem railway on the Wadi-es-Sukar was captured.

On Nov 15 the advance had reached the line Ramleh-Ludd, and a point on the coast only three miles south of Jaffa.

On Nov 16 no considerable advance was made. The enemy claimed a successful resistance on that day but Gen. Allenby reported the receipt of information that the enemy was entrenching a position north of Jaffa in front of the River Anja. To that date some 9000 prisoners had been captured.

On Nov 17 Australian and New Zealand mounted troops entered Jaffa without opposition, the enemy having withdrawn towards the River Anja.

The situation thus created in Palestine is very interesting. Politically the enemy is concerned with the retention of Jerusalem; strategically he must continue to supply his army as he falls back.

The astonishing part of this story of the British advance is the way in which the problem of supply has been solved. The solution is remarkable in view of the distance between the Egyptian base and the first green spot at Gaza. It must be remembered, however, that there has been no set challenge to the British advance since the Gaza-Beersheba line was turned. The crisis of the campaign can only come when the pursuing army reaches some main defensive position on which the enemy has elected to stand.

[The Capture of Jerusalem. By Hilaire Belloc. *Land and Water*, Dec 13 '17. 540 words. 1 sketch.]

General Allenby's entry into Jerusalem has a political aspect sharply divided from its military aspect. The two towns which, for widely different reasons, stand out in the Eastern imagination as representatives of the extended Turkish power, are Baghdad and Jerusalem. Both are now in British hands; and the latter is a symbol of far higher significance than the former, because it appeals not only to the political imaginations of men, but to their religious traditions and to the whole of their past. Further it appeals, not only to the Eastern world, but to the whole of Europe.

The military aspect of the event is this: After he had lost the railway the enemy held the road leading northward out of Jerusalem to Shechem until he had evacuated his stores, men and guns from the south.

It is only subsequent to his evacuation of these southern points, including Jerusalem, that the British force has entered that town; but the success is the fruit of that local decision obtained on the line Gaza-Beersheba, the consequence of which was the rapid advance along the sea plain which gave the British the railway, and with the railway the ultimate occupation of Southern Palestine.

It must not be forgotten that this fine work has depended upon the excellence of the British Engineers.

[Palestine. By Hilaire Belloc. *Land and Water*, Nov 15, '17. 1200 words. 1 sketch.]

The British turning movement around Beersheba and the capture of that point involved the collapse of the whole Gaza line. By Nov 9, over 70 guns had been captured, of which several were 5.9 howitzers. Gen. Allenby estimated on that day the total Turkish casualties, exclusive of 5000 prisoners, to be not less than 10,000 men. The Turks will now elect to stand upon the line farther north along Wady Sukereir from the Sea, southeastward to cover Beit Jibrin and the terminal of the wagon road and highest point at Hebron. The main features of this country with reference to military operations are: First, the absence of obstacles, and second, the difficulty of supply. The railway line to Jerusalem is in rear of the present Turkish line and serves as a good lateral communication for the enemy. The branch of the railway from Beersheba to El Tineh Junction is now in British hands.

SOUTHEASTERN THEATER

Serbian-Salonika Front

[The Allied (Franco-British) Campaign in Serbia, Oct-Dec. 1915. By Major T. E. Compton. *United Service Magazine*, Sept, '18. 4000 words. 1 map.]

The failure to aid Serbia in time was due to lack of men and the hope in Entente circles that Bulgaria would not enter the war with the Teuton Allies. Coupled with this were Greek neutrality and the Dardanelles Campaign, the former depriving the Allies of aid which they had expected thru the friendship and invitation of M. Venizelos, and the latter drawing too heavily upon such man-power as could be spared from the western front.

The Dardanelles campaign is explained as an effort to strike at the heart of Turkey and relieve the pressure on the Russians in the Caucasus, and also indirectly defend Egypt. Russia had at this time what seemed an unlimited man-power upon which the Allies depended to fill their depleted ranks in recompense for the service they were to render until Russia could mobilize. However, the Allied plans at the Dardanelles miscarried, and with only 60,000 men opposed to 300,000 in an entrenched camp there could be but one result.

With but 60,000 men available at the Dardanelles, little material advantage could be gained by sending them to Serbia to hold up the whole Bulgarian Army, so Serbian intervention was proposed by Mr. Bonar Law on the following plan: Occupy the port of Salonika as a base and form an entrenched camp about it. This would safeguard the Kingdom of Greece, and at the same time prevent this port from falling into the hands of the enemy for use as a submarine base for Mediterranean operations. This plan was finally adopted by the French General Sarrail, and in October, 1915, the 156th and 10th British Divisions were transferred from the Dardanelles to Salonika, and two other French divisions, the 57th and 122nd, sent from France. Gen. Sarrail landed at Salonika Oct 12, 1915, and took charge personally.

At this time Gen. von Mackensen was advancing southward and had reached Belgrade. The capital of Serbia was now at Nish, to which place the Serbs asked Gen. Sarrail to send his army. But Nish is 250 miles by rail from Salonika, too far from his base of supplies, so Gen. Sarrail declined. Instead, Gen. Sarrail pushed as rapidly as possible up the valley of the Vardar to effect a junction with the Serbs south of Uskub. The Serbian General Vasitch was at Veles, 30 miles south of Uskub and 100 miles by rail from Salonika.

But Gen. Sarrail had to deplete his force to guard his base at Salonika, to protect his right flank from the Bulgarians, to hold the Demir Kapu defile, and guard the rail-head at Krivolah. All this took one-half of his

EUROPEAN WAR—Continued

force and delayed him, so that when he was ready, his striking force was comparatively small. The Serbs were obliged to give up Veles (Oct 28), which enabled the Bulgarians to drive a wedge between the French and Serbians.

In the defense of the Krivolah rail-head, the French for the first time had an opportunity to feel the effect of their own 75s, these guns having been manufactured in France at the Creusot Works for Bulgaria before the war.

A junction was finally effected with the Serbs holding Balbuna Pass. On account of Greek hostility, Gen. Sarrail established a base outside of Greek territory at Guevli, from where he planned an offensive with the Serbians which resulted in the battle of Kossovo, Nov 4-8, 1915. Altho successful in the battle, the Serbians were forced to retreat towards Montenegro due to the enormous pressure exerted by the army of von Mackensen. After futile efforts to succor the Serbian Army, the Franco-British forces were forced by flanking movements and overwhelming odds of the enemy to retire to what later became the entrenched camp of Salonika. This retreat began Nov 29, 1915.

Much of the blame for this fiasco was placed on the lack of roads for wheeled vehicles. In one instance of the advance of a French division it took 5 days to march 20 miles.

The constitution of the French forces is not given. but that of the British is as follows: Tenth Division (Irish), commanded by Sir Bryan Mahon, consisted of the 29th, 30th and 31st Brigades. The 29th Brigade was composed of the Tenth Hampshires, Fifth Connaught Rangers, Irish Rifles and Leinsters; the 30th consisted of the Sixth and Seventh Dublin Fusiliers, and the Sixth and Seventh Munsters; the 31st included the Fifth and Sixth Inniskilling Fusiliers, and the Fifth and Sixth Irish Fusiliers.

AFRICAN THEATER

German East Africa

[The Conquest of German East Africa. By F. R. Cana. *Sphere*, Dec 15, '17. 1600 words. 1 map.]

After a campaign lasting a year and nine months German East Africa has been conquered by the joint efforts of British and Belgian expeditionary forces. To avoid surrender the last enemy body left in the field fled into Portuguese territory in the closing days of November. The 1917 campaign, the last phase of the conquest, is here described.

Soon after General Smuts relinquished command in East Africa in January, 1917, the rainy season put an end to active operations. It was not until June that the general offensive was resumed by the British. The main force was then under the command of Maj.-Gen. Van Deventer; Brig.-Gen. Northey commanded the Nyasaland-Rhodesia force in the west, while Belgian columns co-operated from the line of the Central Railway. About half the German forces were in the coastal region south of the Rufigi River. These troops were in two parties—one in the valley of the Matandu River, in the hinterland of the port of Kilwa, and the other in the Lukuledi Valley, near Lindi. The other half of the German forces was in the central area east of the northern end of Lake Nyasa, with headquarters at Mahenge. The detachments near the coast were under the command of Col. von Lettow-Vorbeck, Commander-in-Chief of the German forces in East Africa; those about Mahenge were under Gen. Wahle.

Col. von Lettow-Vórbeck had abandoned the valley of the Rufigi in May, taking up his positions near Kilwa. At the same time raiding parties had been dispatched southward. Entering Portuguese East Africa, these parties penetrated to the southeast corner of British Nyasaland. Here they were met by a British column under Col. Shorthose. The raiders suffered severely and were driven back across the Rovuma. Col. Shorthose followed and on Aug 23 occupied Tunduru, an important enemy supply depot.

The main British offensive began on June 10 with an attack on the Lindi detachment of the Germans. With the aid of the guns of warships in the Lukeledi estuary the enemy was driven back for a short distance but was not dislodged from his strong positions covering Nyangao, thirty-five miles inland, important as the junction of the tracks giving access to the Kilwa region. It was not until Oct 17 that Nyangao was captured after very severe fighting. By that time the situation had altered greatly to the disadvantage of the Germans. During July a general attack had been made on the positions southwest of Kilwa. The Germans offered stubborn resistance, and the casualties were heavy on both sides. Nevertheless, by the end of July von Lettow-Vorbeck had been driven back to the Mbemkuru Valley, and a wedge had been pushed between his forces and those near Mahenge. Operations continued without intermission. By the close of September the Germans had been forced from the Mbemkuru well toward Lindi. One of the main objects of the British was to block the roads leading south from Lindi and thus prevent the escape of the enemy from the comparatively small area into which he had been driven. The capture, during October, of Nyangao and the Lukuledi Mission farther upstream did much to insure this.

Meantime Gen. Northey and the Belgians had been active farther to the west. Northey's columns, advancing from the bases of Songea and Lupembe, east of Lake Nyasa, engaged the enemy southwest of Mahenge. Progress was slow due to the extremely difficult character of the terrain, as well as to the stiff resistance of the Germans. Mponda, fifty miles south of Mahenge, was taken on Sept 8. By this time it would have been dangerous for the Germans to retire on Mahenge, as that place was threatened by the Belgians. They accordingly fell back to the east. The Belgian column had started south from Kilossa on the Central Railway in May to co-operate with the British. They fought their way step by step, reaching Mahenge on Oct 9. The Belgian pursuit of their defeated enemy continued for three or four weeks but they finally had to abandon the chase as it became impossible to maintain their lengthy communications. They, however, sent a detachment by sea to Kilwa. This force marched to the southwest

and occupied Livale on Oct 29, blocking the line of retreat to the east of the Germans from Mahenge, now under the command of Col. Tafel. The latter tried several times to work to the east but was prevented from doing so by the Belgians and by two of Northey's columns under Colonels Hawthorn and Fair. In mid-November Tafel suddenly broke southward west of Livale. On Nov 15-16 he was engaged by Col. Shorthose, who had advanced northward from Tunduru. Being in greater strength than the British, Tafel succeeded in escaping by abandoning his sick and wounded, and marched to the southeast in an effort to join von Lettow-Vorbeck.

Gen. Van Deventer had been incessant in his harrying of the force under von Lettow-Vorbeck. The Germans were driven south from the Lukuledi, across the Makonde Plateau, into the valley of the Kitangari. The German forces fought stubbornly and suffered heavy losses both in killed and captured. They were also compelled to abandon most of their field guns. On Nov 21 British mounted troops occupied Nevala, west of the Kitangari Valley. To escape being surrounded von Lettow-Vorbeck hastily retired to the Rovuma Valley on the border of Portuguese East Africa. Col. Tafel, ignorant of what had happened, was now approaching Nevala. He was surrounded by the British troops, and surrendered on Nov 27 with 4500 men. This left von Lettow-Vorbeck's force of less than 2000 fighting men the only German command left in the theater. As soon as the news of Tafel's fate reached von Lettow-Vorbeck he retreated across the Rovuma into Portuguese East Africa. The German flag had disappeared from the last, largest, and most important oversea possessions of the Empire.

It was the settled policy of the Germans in East Africa to avoid any decisive engagement. In a country of such immense distances opportunities to escape from encircling movements were many. Altho a German force is still in being in East Africa, the campaign has been a success. The German casualties between June and December numbered over 11,000. In June the Germans held fully 60,000 square miles of territory; by December all was lost.

While the difficulties presented by the character of the country were one of the principal causes for the prolongation of the East African campaign, the strength of the German forces proved to be much greater than was at first supposed. In all the white troops amounted to some 5000. In the last half of 1914 and thruout 1915 black recruits were conscripted and diligently trained, while by posing as the champions of Islam, the Germans induced most of the Arabs to join their ranks. The Germans put in the field no fewer than 25,000 trained black troops, while fully ten times that number were impressed as carriers. By systematically destroying all the food supplies in the regions they abandoned, the Germans added greatly to the difficulties of their opponents. It is only by bearing all these factors in mind that the magnitude of the task of the British and Belgian forces can be rightly appreciated.

NAVAL OPERATIONS

See also

ZEEBRUGGE—OPERATIONS AGAINST (1918)

[The Operations in Riga Bay. By Hilaire Belloc. *Land and Water*, Oct 25, '17. 1000 words. 3 sketches.]

There has been some misconception with regard to the nature of the operations in Riga Bay and on the islands between that bay and the Baltic. It is reported in the press that a portion of the Russian fleet entered the Gulf thru the Moon Sound and after being defeated by the German fleet retired again thru the Moon Sound northward.

What happened, in general terms, was that a Russion squadron, detached in the Gulf of Riga, containing both light and heavy vessels, was attacked by the German fleet when the Germans had become masters of the Irbe channel at the north end of the Gulf, between the Island of Oesel and the mainland.

The German fleet came thru the Irbe Channel when they had cleared it of mines; drove the Russian fleet northward and cooped it up in Moon Sound. The largest of the Russian vessels, the *Slava*, was sunk by gunfire. Four other ships of considerable draft ran aground. The small craft escaped to the north thru Moon Sound. This sound is practicable only for vessels drawing less than 15 feet of water.

[Germany in the Baltic. By L. Cope Cornford. *Land and Water*, Oct 25, '17. 1600 words.]

The result of the German naval operation, so far, is that the Germans now occupy the whole of the three islands—Oesel, Moon and Dagö, making the northern barrier of the Gulf of Riga.

According to both German and Russian statements, that proportion of the Russian naval forces in the Gulf which has not been wrecked, sunk or destroyed, has retreated northwards; so that the Germans now control all the waters and the coasts of the Gulf of Riga.

Regarded as a naval operation, the capture and occupation of the water and the littoral of this Gulf was a complete success. The feeble resistance of the weak Russian forces was speedily overcome. Germany has long since dominated the Baltic, and this recent enterprise extended that domination. She has gained a valuable naval base at Riga and she now holds the whole line of communication between Kiel and the Riga ports.

The extended control of the Baltic by Germany is likely to affect the position of Finland, where German influence is very little active. Sweden is also directly menaced.

There can be no peace in Europe nor any security at sea so long as Germany holds the Baltic. So far as immediate action is concerned, the Russian Baltic fleet has shown itself to be useless. Germany has once more proved herself to be never more dangerous than when she is talking peace.

[The War, 181st Week, Jan 17-23, 1918. *L'illustration*, Jan 26, '18. 2000 words.]

EUROPEAN WAR—Continued

Naval War

On the afternoon of Jan 20 the cruisers *Goeben* and *Breslau* came out of the Dardanelles. At 5:20 they were sighted two miles from the northeast point of Imbros by the British destroyer *Lizard*, which opened fire and gave the alarm. The destroyer *Tigress* came to its aid, and both destroyers formed a smoke screen to mask the British monitors moored in the Bay of Kouson (N.E. part of Imbros). The monitors *Raglan* and *M-28*, struck by enemy projectiles, sank and the two German cruisers withdrew to the south at full speed.

The *Breslau*, closely pursued by British destroyers, was forced to enter a mine field where it was struck. The Turkish destroyers summoned to its aid were driven away by the British ships. One hundred and seventy-two members of the *Breslau's* crew were rescued and made prisoners.

One hundred and forty members of the crews of the *M-28* and *Raglan* were lost out of a total complement of 310.

The *Goeben* was energetically attacked by British airmen, and was obliged to change its course and steer for the Dardanelles. In so doing she struck a mine and heeled at an angle of about 15 degrees with the stern well under water. She continued to retreat at a low speed protected by the batteries on Cape Helles and escorted by destroyers and airplanes.

The British airplanes continued their attack and scored several direct hits, so that finally the *Goeben* came to rest on the sandy bottom about 1500 meters from the Nagara point. A strong W.S.W. current held the cruiser under the bombs of the British airmen.

The *Goeben* was a German battle cruiser of 23,000 tons and the *Breslau* a scout cruiser of 4550 tons. Both were sold to Turkey at the beginning of the war and renamed respectively the *Sultan Selim* and the *Nedilli*.

[The Navy and the War. By "Admiral." *United Service Mag.*, Mar, '18. 6500 words. 3 tables.]

Shipping and U-boat warfare continue to occupy a share of public attention. Critics point to the failure to foresee the potentialities of the U-boat, yet the fact that Great Britain's share of the war is primarily on the sea has also been overlooked in the past two years.

Recent public utterances indicate that the U-boat menace is being "held." The January (1918) losses are less than those of any previous month since the ruthless submarine warfare started. There may be bad weeks in the future. The U-boats are still active and dangerous, as the loss of the *Tuscania* shows. Building for replacement is of great importance, and Lord Fisher has recently stated that we (British) are building merchant ships at a higher rate than even in our record year, and before the close of 1918 shall be building at more than double the rate of the record year. Lord Jellicoe, in a speech at Hull, predicted that the submarine menace would be killed by August—a remarkable statement for such a cautious man to make.

At the beginning of the war there was a lack of protected harbors, and our ships had to lie in dangerous positions while coaling. Lord Jellicoe deserves credit for the successful provisional arrangements for protection in which he received the loyal assistance of the merchant marine. Warnings of the possbile use of submarines against merchant vessels had not been lacking, but there was a desire to cut down expense, and the Hague conventions and international law were relied upon. Eyes were shut to the changes and precautions necessary on account of the evolution of naval weapons, many of which have been appreciated only under the stress of war experience.

Battleships and battle cruisers are still essential. They may become obsolete, but it would be folly to assume that they are so now. It is not always possible to foresee events. The convoy system, supposed to be incompatible with modern trade requirements, has been re-introduced; and seamanship has been shown to be a valuable quality.

(Follows a discussion at considerable length concerning the effect of the U-boat campaign upon merchant tonnage, the general trend of which is to the effect that additional building and the more effective use of existing tonnage will answer the requirements if the U-boats are "held" as at present.)

Tho the immediate necessity is for merchant tonnage, there have recently been serious losses of destroyers, and it is safe to assume that the balance has been kept between merchant and warship construction.

There is no definite information available as to new British naval construction. No more definite is the knowledge of German construction, but it is a fair supposition from information available that the three dreadnoughts (28,000 tons each and named the *Baden*, *Bayern*, and *Sachsen*) have been completed, and probably also the *Hindenburg* (battle cruiser commenced before the war).

The ex-German cruiser *Goeben* (now Turkish *Sultan Selim*) and *Breslau* (now Turkish *Medilli*) made a foray on Jan 20 against the island of Imbros. The *Breslau* was driven into a minefield and sunk by a mine. The *Goeben* was also severely damaged by striking a mine, and was beached near Nagara Point. There she was bombed by seaplanes for several days, but was refloated and proceeded to Constantinople. The British monitors *Raglan* and *M28* were sunk by the *Goeben* and *Breslau*, and the submarine *E14* was lost while trying to torpedo the *Goeben*.

(Follows a list of nineteen British war vessels lost between Dec 30 and Feb 8, including the two monitors and submarine mentioned, one armed escort vessel, one mercantile auxiliary, two transports, one torpedo gunboat, two destroyers, one armed boarding steamer, one trawler, and seven drifters. The enemy losses are given as two destroyers and two submarines. Other reports of submarine sinkings have been made, but have not been corroborated by the Admiralty. The British merchant losses for five weeks ending Feb 9 are given at 44 large and 21 small vessels. The French losses averaged 3.4 vessels per week, the Italian 1.6).

Many minds are engaged on the subject of anti-submarine measures, but the plans all cost money, and there is difficulty in getting them tried. The submarines

should be attacked directly by guns and bombs, by "camouflage" and deception generally, by airplane, and a serious attempt should be made to stop the holes by attack and by mines.

[The Navy and the War. By "Admiral." *United Service Mag.*, Apr, '18. 6000 words. 2 tables.]

Sir Eric Geddes has, in his capacity as First Lord of the Admiralty, won the confidence of the country by straightforward statements concerning naval affairs. Hence there was anxiety to hear his views when introducing the naval estimates on Mar 5. He was able to repeat his previous view that the U-boats were being "held but not mastered." But the output of the shipyards has been disappointing, and many ships have been lost thru disregard of Admiralty instructions relative to routes, display of lights and by reason of lack of care generally.

The convoy system, notwithstanding the delays and inconveniences, has proved a great success. 35,000 ships have been convoyed with little loss since the system was adopted. For some months past, submarines have been sunk by the American and British forces as fast as they have been built, and one out of four or five of them fails to return to port.

The success of the submarine campaign has had the effect of bringing out the German destroyers, for naval pressure will produce naval action. Even stronger German naval forces may be expected to attack in the Channel.

Two German raiders, the *Wolf* and the *Wolf's Cub*, have returned to Europe after fifteen months' raiding at sea. The Admiralty gave a list of eleven missing vessels, aggregating 32,864 tons, that the *Wolf* is supposed to have sunk, of which 6 were British, 3 American, 1 Japanese, and 1 Spanish. The *Wolf* is believed to have returned to Kiel, but the *Wolf's Cub* went ashore on the Jutland coast, and is reported to be a total loss. These raiders were much less successful than the *Moewe*, which sank 57,000 tons and 112,000 tons on her two raids. Details of the *Wolf's* cruise are lacking.

The collapse of Russia will have far-reaching effects. The Baltic and Black Sea became practically German lakes with full freedom of action. Already the results of German access to Persia via the Black Sea are beginning to be felt in India thru the operations of German agents among the tribes on the border.

Satisfactory reports of shipbuilding operations from America and Canada throw into strong relief our own (British) shortcomings in this respect. Reports from the United States indicate 121,000 tons of shipping in February, 188,000 tons in March, and a possibility of 4,800,000 tons by Jan 1, 1919. Making all allowance for disaffection of certain men in our yards, the *Daily Mail* says that defects of management are also strong factors.

(Follows a detailed statement of naval and merchant losses for four weeks ending Mar 9. Two naval vessels—one an armed transport of 17,500 tons and the other a hospital ship—were lost; of merchant ships 53 large and 16 small vessels were sunk, an average of 17+ per week, an increase over the previous period. The French losses were seven small ships, and the Italian two large and one small.)

A possible further result of the Russian collapse is that the Baltic Sea fleet may fall into the hands of the Germans. An article by Mr. Arthur Pollen shows this fleet to consist of four dreadnoughts, four battle cruisers, four large and two small cruisers, two pre-dreadnoughts, two protected cruisers of some value, and thirty-six destroyers of the 1912 program. Even should these be added intact to the German navy, the United States Fleet will fully counterbalance the addition. The American ships are powerful and efficient, and the British and American navies have demonstrated their ability to work together harmoniously.

The air service is gaining steadily in strength. Numerous raids are made, and we may hope to see soon strong attacks on enemy naval bases.

[The Navy and the War. By "Admiral." *United Service Mag.*, May, '18. 6500 words. 3 tables.]

(This article opens with a discussion of U-boat sinkings of merchant tonnage and its comparison with present rate of construction. In 1917, British losses were 4,000,000 tons and construction 1,200,000. The First Lord of the Admiralty aims at producing 1,800,000 tons this year. The American effort shows 235 shipways for steel ships and 332 shipways for wooden ships, and Mr. Hurley hopes for 4,000,000 tons this year. In addition some tonnage will be supplied by Japan in exchange for American steel.)

The American efforts show an appreciation of the requirements in the way of shipping of an army in France which will probably number over 2,000,000 men by the close of the present year. These must not only be transported but supplied with food and fighting material.

The Russian collapse introduces uncertainties in the naval situation. There are rumors which indicate that perhaps only a few damaged ships may be available for German use in the Baltic. The American fleet will amply counterbalance any German gain from this source.

But the seizure of the Black Sea fleet would create an entirely new situation in the eastern Mediterranean. It is no secret that the British naval force there is inadequate to meet such an addition to German naval strength in these waters. Nor would the French or Italian fleets be of immediate assistance. If Germany is able to use the Black Sea fleet, a serious attack on the Suez Canal and on our (British) eastern communications may be looked for.

The Russian Black Sea Fleet comprises three dreadnoughts, four good pre-dreadnoughts, four modern cruisers, twenty-five destroyers, four submarines, and several smaller vessels.

Such a force could do enormous damage raiding in the eastern Mediterranean. The great naval strength in western European waters should permit the detachment of a sufficient force to meet this menace.

The silent work of the navy continues. Mr. Lloyd-George stated that heavy forces have been transported across the channel recently without the loss of a man,

EUROPEAN WAR—Continued

and the communications to Mesopotamia, Palestine, and Salonika—all dependent upon sea borne supplies—have been kept open. Admiral Sims in a recent speech said that the sea power of Britain and America would enable us to continue the war and eventually prevail thru the exhaustion of the enemy's resources. Moreover, this sea power enables us to renew the combat in any part of the world.

The only naval engagement of any importance during the month was one between 2 British and 3 French destroyers and a German destroyer squadron on Mar 22. Reports state that 2 enemy destroyers and 2 torpedoboats "were believed to have been sunk." One of the British destroyers was damaged but reached a port. The British losses during the month were 1 mine-sweeper, 1 boarding steamer, and 4 destroyers. The losses in destroyers average about one a week, and are undoubtedly serious, but they are doing a necessary work under difficult conditions, so the losses must be borne.

British merchant ship losses for the four weeks ending Apr 6 were 37 large and 27 smaller vessels, a considerable reduction in the loss of large vessels. The average French and Italian losses are about two ships a week.

Certain details of the raider *Wolf's* movements have become known. She sheltered for some time in the South Pacific Islands and New Guinea, making use of an airplane for locating merchant ships to be attacked. She also laid numerous mines off Bombay, Colombo, and the Cape, some of which bore fruit.

The Royal Naval Air Service has been absorbed by the Royal Air Force. It is hoped that it will continue its naval character and be a great success under the new administration. Aircraft now play a great part at sea, especially against submarines.

Commander Simson has given an interesting account of his expedition to Lake Tanganyika in 1915. Two Thornycroft motor boats were taken from England June 12, arriving at the Cape on July 19. The account tells how they were taken by rail, by river, and by roads cut thru the bush, 3500 miles thru the Belgian Congo. They were launched on the lake on Dec 24. Four German vessels were destroyed and the lake—nearly as long as Great Britain—fell into British hands. The party comprised 28 men, and they fought against the tsetse fly, the poison bush, and a pestilential climate, but returned in safety.

[The Navy and the War. By "Admiral." *United Service Mag.*, June, '18. 6000 words.]

(The usual discussion of the destruction caused by U-boats and of building operations in merchant shipping is given. The rate of destruction remains about the same. The British shipbuilding operations resulted in a tonnage completed in April of only 111,533, about three-fourths of the tonnage completed in March. Operations in the United States are far more satisfactory, promising 4,000,000 "dead weight" tons this year, and 8,000,000 from July 1, 1918, to July 1, 1919. "Dead weight" tonnage is much greater than the "gross tonnage" used in British statements, and almost all the repair of damaged vessels falls on the British shipyards.)

The Zeebrugge attack has brought forth praise for the British Navy. It was not merely a happy thought. It was a well-organized scheme. Similar attempts in the past, at Santiago and at Port Arthur (three), had failed, so the undertaking was a bold one in the face of the strong German defenses. The operations at Zeebrugge and at Ostend resulted in losses aggregating 16 officers and 145 men killed, 3 officers and 24 men wounded, 2 officers and 14 men missing, and 26 officers and 355 men wounded—a total of 585 casualties.

In addition to the Zeebrugge and Ostend operations, British destroyers made incursions into the Kattegat on Apr 15, and into Heligoland Bight Mar 28 and Apr 20, besides an action between 5 British and 5 Austrian destroyers in the Adriatic on Apr 22. Monitors frequently bombarded Zeebrugge, and the air attacks on the Belgian coast have been incessant.

—Aeronautics in

See

AERONAUTICS—USE OF IN EUROPEAN WAR
DIRIGIBLES—USE OF IN EUROPEAN WAR

—Asphyxiating Gases, Use of in

See

ASPHYXIATING GASES—USE OF IN EUROPEAN WAR

—Casualties

See

EUROPEAN WAR—LOSSES

—Cavalry—Use of in

See

CAVALRY—USE OF IN EUROPEAN WAR

—Condition of Belligerents

See also

EUROPEAN WAR—MILITARY SITUATION

—Cost

[War Costs and Loans. *Independent,* Jan 26, '18. 250 words.]

Estimates of the cost of the war to the close of 1917 are as follows: United States, $6,000,000,000; Great Britain, $31,250,000,000; France, $20,500,000,000; Russia, $16,500,000,000; Italy, $5,900,000,000; other Allies, $5,500,000,000; Total for Allies, $85,650,000,000.

The cost to the Central Powers is as follows: Germany, $28,600,000,000; Austria, Turkey and Bulgaria, $16,300,000,000; Total, $44,900,000,000.

[Debts of the Warring Nations. *Official Bulletin,* May 6, '18. 200 words.]

The Treasury Department quotes the *London Economist* giving the latest available information relative to the debts of the warring nations as follows:

Allied Nations—

Great Britain	$27,636,000,000	
France	22,227,000,000	
Italy	676,000,000	[x 10?—ED.]
United States	8,000,000,000	

Central Powers—
Germany $25,408,000,000
Austria 13,314,000,000
Hungary 5,704,000,000

—Dirigibles, Use of in

See
DIRIGIBLES—USE OF IN EUROPEAN WAR

—Diseases in

See also
SHELL SHOCK
TRENCH-FOOT
TYPHUS
VENEREAL DISEASES

—Effect on Animals

[The War and the Animal World. *Schweiz. Zeitschrift f. Art. u. Genie,* Sept, '17. 1000 words.]

The war has had an effect on the manner of existence of domestic animals. We note many examples of almost human nobility and sacrifice among horses and dogs. On the other hand we are horrified by the increase in predatory animals, disease-transmitting vermin, and scavengers. The horses have had to suffer in campaign, while those at home have had to perform increased tasks with reduced food—three pounds of oats per day. Many dogs have rendered arduous service at the front as sanitary, watch, and postal dogs. In the former capacity they have pulled wounded men in large numbers from under heaps of dead, thus saving their lives.

Lack of food has necessitated the sacrifice of cattle for their meat. At the same time carnivorous animals in the zoological gardens have died because they could not be fed. Birds have suffered in two ways. The sequestration by the government of all oil- or fat-containing grains and berries has diminished the birds' food supply, and also birds hitherto immune are now used for human food. Crows are now so used. From time to time restrictions are removed on the snaring of new classes of birds. As a result a serious increase in insects, caterpillars, and vermin is threatened. The result of the latter will be a terrible increase in vermin-borne diseases. Game fowl are threatened with extinction. Even fish are caught in greater numbers than before, and small ones shamelessly sold in the markets. What will be the end?

—Engineering—Field Fortifications

See
ENTRENCHMENTS

—Engineering—Field Operations

See
RIVER CROSSINGS—IN EUROPEAN WAR

—Espionage in

See
ESPIONAGE—IN EUROPEAN WAR

—Food and Commodity Prices and Supply

Germany

See also
SUPPLY AND TRANSPORT—GERMANY (Article: "Rationing of the German East Front")

—Forces Engaged

Canada

[Canada's Great War Record. *Sphere,* Oct 19, '18. Quoted.]

Oct 14 was the fourth anniversary of the arrival in England of the first Canadian contingent, numbering 33,000. Canada entered the war with a regular army of 3000 men. At the beginning of September, 1918, she had sent 390,000 soldiers overseas and had another 60,000 in training, while her casualty list has been a heavy one, as the subjoined figures show:—

Killed	43,000
Wounded and sick	113,007
Prisoners	2,224
Missing	384

Of the wounded some 40,000 have returned to the front and 50,000 have been sent home to Canada. Ten thousand decorations have been awarded to Canadian soldiers, including thirty Victoria Crosses.

Germany

[Increase of the German Army from August, 1914, to September, 1917. From *La France Militaire, Memorial de Artilleria,* Nov, '17. 600 words.]

In August, 1914, at the beginning of operations, Germany had 96½ divisions of 4 regiments each (1190 battalions) on the western front, and 26½ divisions of 4 regiments (322 battalions) on the eastern front, a total of 123 divisions, or 1512 battalions.

At the battle of the Yser in November, 1914, she had 104½ divisions (1293 battalions) on the western front, and 32½ divisions (399 battalions) on the eastern front, an increase of 14 divisions, or 180 battalions, over the former period.

At the end of the Russian campaign in 1915 there were 103 divisions of 3 and 4 regiments on the western front, amounting to 1120 battalions, and 67 divisions on the eastern front, amounting to 780 battalions. The increase over the preceding period was 33 divisions, or 208 battalions.

In the Verdun attack of June, 1916, there were 125 divisions, or 1376 battalions, on the western front and 48 divisions amounting to 574 battalions on the eastern front, an increase over the previous period of 3 divisions or 50 battalions.

At the time of the new Russian and Rumanian offensives in December, 1916, there were 129 divisions or 1312 battalions on the western front, and 79 divisions or 899 battalions in the east. The total increase this time was 35 divisions, or 261 battalions.

During the time of the Franco-British offensives (July 1, 1917) there were 155 divisions on the western front and 79 on the eastern front, giving a total of 2316 battalions and an increase of 26 divisions, or 105 battalions.

In September, 1917, during the counter-offensive on the eastern front, there were 147 divisions, or 1369 battalions in the west, and 92 divisions or 965 battalions in the east. The totals were now 239 divisions and 2335 battalions, an increase of 5 divisions, or 18 battalions.

EUROPEAN WAR—Continued

The total increase from August, 1914, to September 1, 1917, was 116 divisions, or 822 battalions.

[German Divisions Disbanded. *Canadian Mil. Gazette,* Sept 24, '18. 150 words.]

Seven of the German divisions on the Western Front have been disbanded for lack of men. Of the 195 German divisions on the entire front, only 16 have not been engaged in the heavy fighting of the present year. In at least 8 divisions, the battalion formation has been reduced from four to three companies.

[The War on Land. By a Military Officer. *Army & Navy Gazette,* Oct 12, '18. 1400 words.]

Three months of the offensive under Marshal Foch has not only arrested the German offensive forever, but has also inflicted such losses on the Germans as to necessitate the disbandment of division after division for lack of drafts of trained men. This loss of divisions amounts to about 20, and it may well be that Germany has had to choose between a "peace offensive" and the abandonment of her holdings in Russia and Rumania in order to withdraw troops from these regions. The Bulgarian surrender has made the situation more acute for Germany.

Little is known regarding German strength in the east. The German newspapers have said nothing on the subject. It has long been known that von Mackensen had in Rumania a minimum of six divisions, but they have been doing police duty and are probably below strength, short of artillery, and without the regular proportion of technical troops.

We know little relative to possible withdrawals of German troops from Russia without the immediate collapse of German influence.

Certain items of information have been given out by the French Staff. This information speaks of divisions, but the value of these units is not known in all cases. There is in Finland about the equivalent of one division under von der Goltz, scattered over Finland and hardly to be reckoned. The Baltic Provinces and part of White Russia were held in the north by the 8th Army under von Kathen. There was a central detachment at Dvinsk, and the 10th Army with headquarters at Minsk. The greater part of these armies is now composed of second-rate troops, but these might be used to set free other better units for the western front. Between the Baltic and the Ukraine there were fourteen or fifteen landwehr divisions, with four first-line units and some cavalry elements.

In the Ukraine is von Kirchbach's Army, with a number of landwehr divisions, but no less than ten "active" divisions and three cavalry divisions. There are also some half dozen Austro-Hungarian units and some Hungarian cavalry. Of the six divisions in Rumania, three are German and three Austrian. A few Austrian divisions are in reserve in Galicia and Bukowina.

On the most favorable view for the enemy, Germany had a month ago in the east fewer than 20 divisions fit for western front work. Hence the peace notes, and possibly the denudation of the eastern front of all good troops.

Great Britain

See also

Great Britain—Military policy of (Article: "Great Britain's Man Power")

India

[India's Part in the War. *Canadian Military Gazette,* Oct 22, '18. 100 words.]

India has furnished to July 31, 1918, 1,115,189 men to the British Army. They have fought in France, Mesopotamia, Egypt, the Dardanelles, Salonika, East Africa, and Central Asia. War loans have aggregated over $400,000,000.

India has sent to various theaters of war more than 1500 miles of railway track, 250 engines, and 4500 cars.

United States

[Our Army's First Anniversary Abroad. *Army & Navy Jour.,* June 29, '18. Quoted.]

"In referring to the fact that June 26 marked the anniversary of the landing of the first American troops in France, Secretary of War Baker said on June 25 regarding the proportion of our fighting troops in the American Expeditionary Force to the non-combatants that, "roughly, between sixty-five and seventy per cent were combatant troops, nearer seventy than sixty-five." In addition to being the nearest approach to a public statement we have had on this matter, Mr. Baker throws a clearer light on the announcement made on June 21 at the meeting of the War Council that our troops were holding thirty-nine miles of the western front as American commands, in addition to which "there were large numbers of American troops at the front with British and French units." According to the statement made on June 21 by members of the House of Representatives, who attended the weekly meeting of the War Council, the A. E. F. units holding this thirty-nine miles of front were all commanded by American officers and were stationed at six different points along the Allied line in France. On the customary basis of a division of troops to one and a third miles of front, this would require twenty-nine divisions of American troops to such a length of front unless the line was very thinly held, as may be the case where some of our men are in Alsace. On a basis of 18,000 to a division, this would work out to 522,000 men. Since the total number of our forces in France on June 15 was 800,000 men, not all of which were thoroly trained effectives, it would appear that either parts of this line were more thinly held than is the most recent practice or we have lessened the number of men in a division. On a seventy per cent basis our 800,000 men of June 15 would produce 560,000 combatants.

That the American Army is holding that length of the Allied line is in itself no mean achievement by the time we are marking the anniversary of the first landing of American troops in France. That we are holding the line is proof of the fact that we must have at least twenty-five divisions of trained effectives in the

field, for otherwise General Foch would not entrust so considerable proportion of the front to General Pershing. Cantigny proved the merits of that officer as a commanding general and the ability of the officers and men under him to fight in the war of positions with a perfect mastery of the tactics of that order of warfare. Chateau-Thierry, and now Belleau Wood, justifies the trust put in our men, as does the unanimous praise of gallantry, their discipline, their perfection in tactical methods. Altho less spectacular, the work of the Quartermaster Corps in equipping the men for service abroad and providing for them while in France has been the most remarkable achievement of that resourceful body of officers; and the same thing must be said for the Corps of Engineers, whose work in France alone furnishes one of the most thrilling features of this anniversary's retrospect. The accomplishments of the Medical Corps in France not only have been of the highest order technically, but also have aroused in the French surgeons and people the most profound admiration and gratitude. Secretary Baker's comment, "I think this year's work is satisfactory," is one that will be echoed by the American people and by the American Army."

[General March's Weekly War Review. *Army & Navy Jour.*, June 29, '18. Quoted.]

The most striking statement made by Gen. Peyton C. March, Chief of Staff, U. S. A., in his weekly review of the war situation on June 22 was that "the United States has now crossed the 900,000 mark of troops shipped from ports in America; this includes men in France and on the high seas, combatants and non-combatants, in which class are counted medical men and the service of supply." General March made this statement after describing and analyzing the Austrian drive on the Italian front and pointing out how "the lack of fighting along the French front is of primary importance to the Allies by giving us a chance to get more man-power." He continued: "One of the most striking things noticeable in the situation as it is shown on the western front is the supreme importance of having a single command. The acceptance of the principle of a single command, which was advocated by the President of the United States and carried thru under his constant pressure, is one of the most important single military things that has been done as far as the Allies are concerned. The unity of command which Germany has had from the start of the war has been a very important military asset, and we already see the supreme value of having that central command which now has been concentrated in General Foch.

"Referring again to our own troops," General March continued. "Nine hundred thousand men is a large command and in it are Regular Army troops, National Guard, National Army, and a small force of Marines. The Marines amount to some 12,000 men altogether. We have colored troops over there who are fighting well. So far, whenever the test has come, regardless of the character of the troops themselves, the American troops have done well. The fight at Cantigny was handled by our First Division, under Major Gen. Robert L. Bullard, and was a very striking example of the high-class team work between Infantry, Field Artillery, and particularly the Staff. It shows that our Staff training, which is one of the most important things in connection with a modern army, has now reached the point where it can work successfully. The First Division is the first division not only numerically, but the first division landed in France, and is now a thoroly trained, high grade unit, and so far has always delivered the goods. Other units, like the Rainbow Division, which was organized from all the states in the Union from National Guard units, commanded by Major Gen. C. T. Menoher, is a fine representative of the National Guard, and has also done high grade work. At the Chateau-Thierry fighting, altho the number of our troops engaged was small, a good deal of important work was done by machine gun units under a major whose name I do not know. The whole brigade at that point was commanded by Brig. Gen. James G. Harbord, who was recently Pershing's Chief of Staff and who has been transferred to that brigade. The 26th Division is reported as doing very well.

"The general situation looks well. This present lull on the western front simply means that Germany is refitting her combat divisions and preparing for another drive. It does not mean that the great battle is over at all. We can look forward to a renewal and repetition of what we have been passing thru these past few months, as far as German activity is concerned. The United States is about five months ahead of its program."

[Over a Million Men . . . on French Soil . . . *Official Bulletin*, July 3, '18. 600 words.]

In a letter to the President, the Secretary of War has made public the following data with reference to the transportation of U. S. troops to France.

". . . The first ship carrrying military passengers sailed May 8, 1917, having on board Base Hospital No. 4 and members of the Reserve Nurses Corps.

Gen. Pershing and his staff sailed on May 20, 1917.

The embarkations in the months from May, 1917, to and including June, 1918, are as follows:

1917—	
May	1,718
June	12,261
July	12,988
August	18,323
September	32,523
October	38,259
November	23,016
December	48,840
1918:	
January	46,776
February	48,027
March	83,811
April	117,212
May	244,345
June	276,372
Marines	14,644
Aggregating	1,019,115

The total number of troops returned from abroad, lost at sea, and casualties is 8165. . . ." of which, due

EUROPEAN WAR—Continued

to the superbly efficient protection of the navy, only 291 were lost at sea. The supplies and equipment in France are adequate.

[More Than 2,000,000 of Our Men Abroad or on the Way. *N. Y. Times,* Oct 24, '18. 600 words.]

The Secretary of War, in a letter to the President, has given the following information relative to sailings of troops:—

Embarked to	July 1, 1918	1,019,115
"	July	306,185
"	August	290,818
"	September	261,415
"	Oct 1-Oct 21	131,398
	Total....	2,008,931

—Fortifications, Experience with

See also

ENTRENCHMENTS—USE OF IN EUROPEAN WAR

FORTIFICATIONS—PERMANENT—USE OF IN EUROPEAN WAR

[The Experience Gained during the English-French Offensive in the Spring of 1917. *Infantry Jour.*, Feb, '18. 5000 words. 1 sketch.]

(This article is the translation of a German official document and shows their methods of procedure and some of the reasons for the change in their method of construction of positions for defense.)

Some of the principles regarding the construction of field positions and command in battle, as laid down in the "Manual of Position Warfare For All Arms" have been emphasized during the recent Franco-British offensive. The *most important points,* especially those which were *not universally observed and do not yet appear to be fully understood* are discussed under the following subjects:

I. Construction of Field Positions

1. More screens and dummy works must be used to make all works as invisible as possible to ground and air observation.

2. A broad defensive zone must be prepared, with many defensive works, organized in depth and mutually flanking each other. These works, altho not extraordinarily strong, must be numerous enough to cause the enemy to scatter his ammunition.

3. Continuous fire trenches and communication trenches, good entanglements and dugouts alone enable a small garrison to permanently hold a position and are indispensable in the battle.

4. The strength of the position must increase from front to rear.

5. The requirements of the artillery must be carefully considered in the selection and preparation of positions.

6. Forward slope and reverse slope positions are not always properly appreciated.

7. The positions selected for the machine guns and the dugouts must form the framework of all infantry battle positions. The importance of an inconspicuous disposal of the machine guns and the dugouts in depth cannot be too much emphasized. Deep mined dugouts in the front line have proved to be man-traps.

8. Great attention must be paid to well-thought-out improvements of the road and railway systems of collecting dumps of building matériel, stores, and ammunition, and to measures for the accommodation and welfare of the troops.

9. Villages require too many troops and are particularly good targets for artillery and for these reasons should not be included in the actual scheme of defense for the battle.

10. The construction of defenses during the battle within the foremost battle zone is not proper because it demands too many men who could be employed in the fight.

11. The construction of rearward positions should be given more careful attention.

12. After the conclusion of the battle it is not advisable to convert the shell-hole positions into new fighting positions. The second or rearward positions should be selected and the shell-hole area should be held only by outposts.

II. Garrison

1. The width of the divisional sector must frequently exceed 3300 yards. The divisions are usually capable of warding off attacks without help, but often they must be backed up by counterattack divisions.

2. The principle of allotting a weak infantry garrison to the front line, distributing the machine guns in depth and checker-wise behind this line, detailing emergency garrisons at sector boundaries and providing protection for machine guns has been shown to be usually correct. The reserves must be kept well up and so handled as to prevent excessive crowding in the foremost fighting zone. Every unit must pay attention to the security of its flanks.

3. Distribution in depth is as necessary for artillery and trench mortars as for infantry and machine guns. Whenever the distance between us and the enemy permits, the foreground will be held by advanced troops of all arms.

III. Conduct of the Battle

1. To hold the foreground of the position with outposts has proved effective.

2. The defensive battle must be commenced in good time.

3. The superiority of an active defense, carried out in the spirit of an offensive, shou'd be emphasized. We have been obliged to learn to lose a number of positions rather than to incur heavy casualties to no purpose.

4. Greater adaptability on the part of all troops during the battle is necessary. It is better to move towards the enemy whenever shelled out of our trenches. Infantry and machine guns will do better to try to engage the enemy in the open, finding cover from observation in the shell holes and using the trenches during the more quiet periods.

The difficulties of command, supply and relief will be increased and every effort must be made to establish communication between crater and crater. Such

positions will require the infantry to take the offensive and all commanders, even of comparatively small units, must be given certain freedom in the selection of the tactics to be employed.

5. Each unit must maintain intact the ground entrusted to it and a definite evacuation of any piece of ground can only be carried out by order of the higher commander. The offensive-defensive and immediate and independent counter attack must become second nature to every man and every commander.

6. The immediate counter attack plays the decisive rôle in the defense, and should strike the successful enemy at the moment of his success; if possible, by surprise and in flank. It still frequently occurs that the strength of the infantry detailed for an objective is excessive.

7. An increased expenditure of ammunition, particularly for counter-battery work and on living targets is necessary. Many mistakes are still made in this respect. Gas shells must be employed before the beginning of the enemy's attack. Our artillery fire is too rigid and results achieved against assaulting infantry are not in proportion to the number of guns and ammunition used. Artillery fire must be flexible and can only be made so by proper aerial observation and artillery communication.

8. Much is to be learned in the co-operation of airplanes and balloons with the troops. The work of contact patrols and artillery airplanes is particularly valuable.

9. The value of "Minenwerfer" in the defensive battle is considered doubtful in several quarters.

IV. General

1. Legitimate complaints are made as to the enormous increase in the amount of clerical work.

2. Departures from instructions in the "Manual of Position Warfare for All Arms," including this special part, will not be permitted under any circumstances.

—Fortifications, Use of in

See

FORTIFICATIONS—FIELD—USE OF IN EUROPEAN WAR

—Individual Experiences in

[Experiences with the Russian Army of the Caucasus in Northern Persia. By Lieut. T. L. Hazlett, M.O.R.C., U.S.A. *Military Surgeon*, Oct, '17. 2000 words. Illustrated.]

(A short chronicle of observations and experiences of the writer while serving with the American Field Hospital attached to the Russian Army of the Caucasus. The hospital was situated in the Persian town of Knoy, on the desert seventy miles from Julfa, the termius of the only railroad leading into Persia. All supplies were brought up by camel caravans, ox carts and donkeys, the sand being too deep for automobile transport.)

—Infantry in

See

INFANTRY—USE OF IN EUROPEAN WAR

—Losses

Great Britain

[Notes of the War. *Army & Navy Jour.*, Dec 8, '17. 400 words.]

British casualties reported during November totaled 120,089, divided as follows: Killed or died of wounds—officers, 1152, men, 24,292; wounded or missing—officers, 3537, men, 91,108. The increase is not directly attributable to the losses in the Cambrai drive, as the British War Office has asserted that the losses were less than the number of prisoners taken, which was between 10,000 and 11,000.

British casualties in the week ending Dec 4 totaled 28,822 as follows: Killed or died of wounds—officers, 169, men, 6153; wounded or missing—officers, 494, men, 22,006.

The British captured on all fronts in November 26,869 prisoners and 221 guns. Of these captures 11,551 men and 138 guns were taken on the western front.

[English Losses. Foreign Service Opinion. *Army & Navy Gazette*, June 22, '18. 200 words.]

The *Toierische Landeszeitung* of June 1 states:—The 8th English Division took part in the spring fighting from Mar 21. After a brief rest at Amiens it was taken to the new front, relieving the French and where it was again surprised by a German attack and cut off soon after the beginning of the battle, the losses being about 80 per cent, the 25th Brigade suffering especially. The 64th Brigade lost 33 per cent prisoners and 30 per cent casualties while the 62nd lost 50 per cent prisoners and 20 per cent casualties. The 110th Brigade lost in all 85 per cent. The 7th Brigade of the 25th Division, sent to reinforce the 62nd Brigade of the 21st Division at Cormicy, lost in casualties 50 per cent, while the Pioneers of the 25th Division, which had reinforced the 64th Brigade, lost at Hermionville 40 per cent of their strength in killed, wounded, and prisoners. In the German attack of the 27th, the 50th English Division had 60 officers and 1861 men captured between Bouconville and Corbeny, and lost over half its numbers.

[Notes of the War. British Casualties. *Army & Navy Jour.*, Nov 2, '18. 50 words. Quoted.]

The British War Office announced, Oct 28, that the casualties for the week ending that date were 32,249, as compared with 37,150 for the previous week. They are divided as follows: Killed or died of wounds—officers, 436; men, 5307. Wounded or missing—officers, 1141; men, 25,365.

Italy

[Note Relative to Some Sanitary Statistical Data of the Present Italo-German War. By Dr. (Maj.) Duilo Balestra. *Military Surgeon*, Dec, '17. (From *Giornale di Medicina Militare.*) 3000 words.]

The figures presented in this article cover all the Italian troops mobilized in the zone of operations during the period from the beginning of the war to the end of June, 1916. For greater simplicity and to make comparison possible, the period is divided into two

EUROPEAN WAR—Continued

parts, the first starting at the beginning of operations and extending until the last day of 1915, and the second from Jan 1 to June 30, 1916.

The figures concerning ordinary diseases relate only to those sent to hospitals. Persons treated in the troop corps infirmaries are not considered, as their affections were so slight and of such short duration that they scarcely diminished the numerical strength of their organizations. The daily average morbidity on this basis was 2.71 per 1000 in the first period, and 1.57 per 1000 in the second. This gratifying showing is enhanced by the fact that an examination of the causes for hospital admissions shows that the ordinary medical and surgical diseases increased from 71.30 per cent in the first period to 84.61 per cent in the second. This clearly indicates that the diseases which may be most directly influenced by hygienic and prophylactic measures underwent a very sensible diminution as the campaign progressed.

The percentage of wounded in relation to the strength of the troops actually engaged in fighting was: First period, 7.13; second period, 5.06. This percentage was much lower than had been expected. The proportion of grave wounds was, on the other hand, higher than anticipated. Classifying the wounded according to the severity of their injuries, the percentages for the two periods were as follows: Severely wounded, 31.60 and 23.62; slightly wounded, 55.38 and 63.01; very slightly wounded and able to return immediately to their corps, 13.02 and 13.37. The percentages for the two periods according to the causes of the wounds were: Artillery, including hand grenades, 46.91 and 54.74; portable arms, 52.60 and 39.16; cutting instruments, 0.36 and 0.59; asphyxiating gas, 0.13 and 5.61. The enormous difference between these last figures and the data furnished by past wars is immediately apparent. Even in as recent a war as the Russo-Japanese the number of wounds from small arms far exceeded that from artillery, the percentage being 80 for small arms, 15 for artillery and 5 for cutting instruments. The excess proportion of wounds from artillery has constantly increased as the war progressed. An estimate from one army corps for a period later than that for which complete figures have been obtained places the ratio of artillery wounds to those from small arms at 3 to 1.

The proportion of mortality in the Italian Army per 100 wounded was: Dead on the field of battle, 5.47 during the first period and 7.87 during the second; dead as a result of wounds, 11.24 and 10.16. The totals show that the mortality in this war has been a little lower than past experience would indicate. The figures for died of wounds seem a little high when modern equipment and technique are considered, but it must not be lost sight of that the great preponderance of artillery wounds has increased the gravity of the average wound and rendered grave complications more frequent.

Considering the proportion of officers and enlisted men killed it is found that the ratio was 1 officer to 29.8 men in the first period, and 1 officer to 27 men in the second.

United States

[Total Casualties in U. S. Army and Marine Corps 10,383 From Beginning of the War and Including June 30 Report. *Official Bulletin*, July 1, '18. Quoted.]

The following weekly statement is authorized by the War Department:

The total number of casualties to date, including those reported yesterday (June 30), is as follows:

Killed in action (including 291 at sea)	1491
Died of wounds	479
Died of disease	1287
Died of accident and other causes	465
Wounded in action	5024
Missing in action (including prisoners)	385
Total	9131

The Marine Corps authorizes the following summary of its casualties to date:

Officers:	
Deaths	14
Wounded	29
Missing	1
Enlisted Men:	
Deaths	393
Wounded	813
In hands of enemy	1
Missing	1
Total casualties	1252

[Casualties in Forces Abroad. *Army & Navy Jour.*, Nov 2, '18. Quoted.]

Total casualties in the American Expeditionary Force in France up to Nov 1 were given out as follows: Killed in action, 10,589; lost at sea, 623; died of wounds, 3987; died of accident and other causes, 1178; died of disease, 3539; total deaths, 19,916. Wounded, 34,024; missing, including prisoners, 6226. Grand total, 60,166. Marine Corps casualties totaled 3991.

—Losses—Artillery

[Wastage of German Artillery. *Canadian Military Gazette*, Jan, '18. 250 words.]

A secret report of the German Staff signed by Ludendorff himself shows the alarming losses of German artillery. It stated that during grand operations the average number of guns lost by a single German army in a single month either by wear and tear or by enemy fire are as follows: Field guns, 870; Heavy pieces, 585. Of an average of 1455 guns put out of action it appears that 655 were lost by wear and tear and 800 by the Allied bombardments.

[British Artillery Losses. *Army & Navy Jour.*, May 11, '18. 450 words.]

The first official British statement as to the losses of the British army in artillery and machine guns during

the German offensive that began on Mar 21 was made byWinston Churchill, Minister of Munitions, in Parliament on Apr 25.

"We lost," the Minister said, "nearly a thousand guns by shell fire or capture; between 4000 and 5000 machine guns have been lost or destroyed and the quantity of ammunition, apart from that which has been fired and that which has been lost in the dumps, amounted to something between one and three weeks' total of manufacture. Other war materials have been used or lost in a great variety of classes and on a similar scale, but by the end of last week (i.e., week ending Apr 20) all the losses had been made good and in many cases more than made good.

"Vast quantities of small-arm ammunition have been lost or left behind, but, great as the demand has been, the expenditure in the past month did not exceed the maximum potential capacity of the British factories, without touching enormous reserves which had accumulated against such a contingency. The wastage of rifles was very great, but the losses were quite easily and promptly made good. Our preparations had contemplated a period of supreme battle intensity from the third week of February instead of from the third week of March, so we are at present from one to three weeks to the good.

"Those calculations allowed the artillery to fire during the whole fighting season a considerable heavier volume of shells than was expended weekly during the offensive battles of last year, and more than double the volume of shells fired during the terrific bombardment which characterized the Somme offensive of 1916. They also provide for the carrying forward into 1919 of sufficient reserves to allow the British total to mount one step higher then in power and intensity. In fact, barring unforeseen circumstances, our supply of munitions would enable us to carry on a battle at the supreme pitch of intensity until winter without compromising our requirement for 1919. This is despite the fact that a hundred thousand men were taken from munition factories for service in the army."

—Military Lessons of the

See also

BALKAN WARS—MILITARY LESSONS OF THE
EUROPEAN WAR—FORTIFICATIONS, EXPERIENCE WITH
MACHINE GUN—FIELD USE OF

[Sir Douglas Haig Questioned. *Sphere,* Feb 2, '18. 3000 words.]

(*Note.*—This article is in the form of questions, the answers to which are taken from Sir Douglas Haig's official report, January, 1918. The article summarizes the military information to be gleaned from that report.—ED.)

From the Scarpe at Fampoux to Lievin the German trenches comprised three separate systems connected by a switch line, forming a belt two to five miles in depth. Three to six miles further east a new line of resistance—the Drocourt-Queant line, was (early part of 1917) approaching completion.

Trench mortars have continued to play an important part in supplementing artillery fire and in the preliminary stages of our (British) offensives.

Unbroken wire, unavoidable weakness of artillery support, and machine gun fire have been the obstacles at different times to the successful use of cavalry in connection with offensive actions.

The water supply in the Messines area offered difficult problems, solved by carrying pipe lines forward as far as possible and making provision for rapid extension. By June 15, 450,000 to 600,000 gallons was being supplied daily to Messines, Wytschaete, and the Dam Strasse.

The transport of supplies was so efficiently organized by pack animals and carrying parties that during the attack water reached the troops within 20 to 40 minutes of the taking of new positions. In one case, carrying parties arrived and dumps were formed within four minutes of the capture of an objective.

In the third battle of Ypres the counter-battery work of the artillery was so effective that the Germans commenced to withdraw their guns. The attack set for July 25 was postponed three days, and some of the British guns were moved to more advanced positions.

"In the Langemarck district, the 'pill-boxes' (concrete machine gun emplacements), distributed in depth all along the front of our advance, offered a serious obstacle to progress. They were heavily armed with machine guns and manned by men determined to hold on at all costs. Many were reduced as our troops advanced, but others held out thruout the day, and delayed the arrival of our supports. . . . The enemy had adopted a system of elastic defense, in which his forward trench lines were held only in sufficient strength to disorganize the attack, while the bulk of his forces were kept in close reserve." Documents captured later indicated that the German Higher Command recognized the failure of these methods and were endeavoring to revert to an approximation to their old method of holding the forward positions in strength.

In the Messines Ridge attack, twenty-four mines were used, of which four were outside the front of attack and one was lost because of a mine blown by the Germans. Many of these mines had been completed for 12 months prior to the attack. Over 1,000,000 pounds of explosives were used in these mines, an amount without parallel. The Germans were aware of their danger, and themselves had a deep mining system.

The Germans did their utmost to hold their ground against the Flanders offensive, and used up no less than 78 divisions, of which 18 were engaged a second or third time. The number of divisions on the fronts not attacked was reduced to a minimum, requiring of them constant vigilance and unremitting labor.

There must be the closest co-operation between the air and land arms. A definite aerial offensive, in which long-distance aerial raiding has taken a prominent place, has become a recognized part of the preparations for infantry attack. The losses in this aerial offensive were severe on both sides, but the British

EUROPEAN WAR—Continued

machines enabled the guns to carry out their work effectually.

"During the past year (1917), the use of the machine gun in offensive warfare has been considerably extended. The machine gun barrage has taken a definite place with the artillery barrage in covering the advance of our infantry, while the lighter forms of machine guns have proved of great assistance in the capture of hostile strong points.

"Gas discharges have become matters of almost *nightly* (italics ours.—ED.) occurrence, and have been carried out at points all along the line. A total weight of nearly 2000 tons of gas has been liberated in 335 separate discharges. Evidence accumulates of the serious casualties inflicted on the enemy by gas and kindred methods of offense."

The number of broad gauge locomotives in use in October, 1917, was nearly ten times as great as at the end of 1916, and many hundreds of miles of broad gauge track have been laid.

The "Tanks" have proved their worth and have amply justified the labor, material, and personnel diverted to their construction and development.

The troops are making steady progress in efficiency, and the fighting superiority of the British soldier has been asserted with ever-increasing insistence. This feeling permeates the troops themselves, and is a guarantee of victory. The Army Commanders have most completely fulfilled the high standard of character and ability required of them.

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[Deductions from the World War. By Baron von Freitag-Loringhoven. *La Guerra y su Preparación,* Nov, '17 16,000 words.]

Influence of Technics

War technics affect the employment of weapons, protection against them, means of communication and information and aerial warfare. They are brought out only by war itself. The Russo-Japanese War was fought with a small variety of elements as compared with this struggle. The real importance of war technics was not felt until after the Russo-Japanese clash. This importance has been growing ever since that time.

Moltke realized the importance of railroads as one means of carrying on war, and saw to it that they were properly developed for this purpose. In 1914, at the opening of the war, our (German) railroads transported one and one-half million soldiers to the western front. Railroads have played an important part in maneuvers which have taken place at the various fronts from time to time. Transportation by rail used to be considered less important than marching. The disadvantage was that the route of march must agree with the direction in which the rails were laid, in the former case, while in the latter the direction of march could be changed at any moment. The construction of railroads has been such that at present a fairly direct rail connection exists between any two points on a front, and between points on different fronts.

The increased size of modern armies makes railroads essential to their proper employment. In open warfare the railroad alone can keep the army in motion. In trench warfare only the railroads can carry the necessary food, ammunition and supplies, evacuate the wounded, and keep the sanitary service in operation. The motor truck has not, as yet, replaced the railroad.

Neither have railroads been exposed to the terrible destruction that was looked for. In case of destruction the damage is always local and can be easily and quickly repaired. In the Macedonian campaign in the fall of 1915, where the railroads encountered special difficulties and were forced to stop, all military operations were consequently paralyzed.

General Friederich attributes the failure of Napoleon's simultaneous campaigns of 1815 in Saxony, Silesia, the Marcs, the Lower Elbe and Bavaria to the lack of railroads and telegraphy. And for those times his army of one-half million men had used every technical element available.

After starting his first army into action Napoleon returned to Dresden on the 28th of August. He did not known of Oudinot's defeat at Gross-Beeren and Macdonald's at Katzbach until Sept 3. The distances between him and these forces were from 50 to 100 kilometers. This is an example of the difficulties encountered in those times in maneuvering independent army groups, tho they might be relatively close to each other.

Even after the appearance of telegraphy and railroads all the difficulties of command were not solved because of the deficiencies of installation and the scarcity of both. In the battle of Königgratz the attack order for the 2d Army was carried 40 kms. on horseback. In this war the telephone and wireless telegraphy have placed the transmission of orders and information on a totally different basis. The horse messenger has been replaced by the automobile and motor cycle. Railroads and fast automobiles have enabled commanders, or their representatives, to exchange views verbally. Compared with past wars the war mechanism of to-day has functioned very smoothly. This was absolutely necessary, considering the great masses employed and the extension of operations. But, however valuable contemporary auxiliary elements may be for high commanders, war still remains in the field of uncertainty.

Aerial navigation has offered many new advantages as an element of war which had never been considered. The dirigible is worth a great deal as a sea scout but it has been driven off of the land by the airplane. The Zeppelins are too delicate. They have to operate at a very high altitude because they offer such a large target; this diminishes the accuracy of their bombing. They also require much material and a large crew for their repair, besides immense hangars. The Zeppelin is a war element of moral value. It was especially valuable at the beginning of this war when it carried us to England. The importance of the airplane was greatly increased when it was able to acquire an altitude of more than 3000 meters, thus

reducing its visibility as a target. The airplane is a tactical and strategical scout.

Airplane photography shows the actual condition of the enemy's trenches, while long distance scouting machines bring back information of movements going on behind his lines. Airplanes are important as means of dropping bombs on enemy positions or depots.

The captive balloon is a means of giving fixed observation. Both captive balloons and airplanes are used to regulate field artillery fire. The French were the first to use the airplane for this purpose.

Th attack of interior enemy military and supply establishments by bombing squadrons has been highly developed. Open towns often suffer as a result of these bombardments.

The submarine is a new element of war which is proving its own worth. In this struggle caused by economical conditions, war is being directed more and more against the enemy countries. The old principle of fighting only the enemy's armed forces has been relegated to a second place before the necessity of destroying him economically.

As far as infantry is concerned, absurd as it may seem, the use of the rifle has decreased in importance. The old idea that the decisive infantry engagement was fought at a range of between 400 and 800 meters has been disproved. The Russo-Japanese and Boer wars offer examples where infantry maintained themselves at close range with the rifle alone, but trench warfare has caused the rifle to be replaced by the cutting weapon and the hand grenade.

Von Moltke, in 1865, considered fire effect and fire superiority the first essentials to a successful bayonet assault, but he laid great stress on the necessity of training men to have confidence in the bayonet.

Trench warfare has also developed mining warfare, and such weapons as the trench mortar, and the modern catapults and ballistas for throwing explosives. Entirely new weapons have appeared such as poisonous gases, gas shells and, for defense against these, the gas masks. The French and English attempted to open a way for the attack of their infantry by the use of armored tanks. This war has revealed more technical and scientific inventions than any other. The way in which German industry and German chemistry have fought the science of the rest of the world will always be a glorious page in our history.

Artillery ammunition reserves fell far short of the amount required, but it was impossible to accumulate the required quantities in time of peace. A critical point in artillery ammunition shortage was reached in the autumn of 1914 when our infantry at many times was not properly supported. German industry again rose to the occasion and production was enough to offset the huge shipments received by our enemies from America, Japan and Russia.

Targets are constantly getting closer to the ground, and the adoption of artificial protection is becoming more general with a corresponding increase in the use of curved or high-angle fire. At first our heavy artillery was decidedly superior to the French, but this superiority was in part offset by a very mobile organization of the French batteries. During the course of the war both the French and English have used the largest caliber artillery against us.

Our trenches, and those of our enemies, both in the east and west, assumed the character of fortifications from day to day. These trenches are always protected by barbed wire, which is made in enormous quantities. This condition, added to the surprising results achieved by our heavy artillery and the Austrian auto-mortars against the Belgian and Russian fortresses, assures the future replacement of all fortifications by the wired trench.

Of course, a frontier will always be protected by certain strongly fortified points, where defensive warfare is planned. The value of such points is well shown by Verdun and the fortified Moselle front. Even our heaviest cannon could not dominate the works at Verdun so that they could be assaulted successfully. Well-hidden, carefully situated fortifications have an immense value where the terrain is favorable for their location.

The fortification of cities is out of date. Cities will remain important as mobilization points in a fortified zone.

These mobilization points will continue to be important as long as frontier zones have to be secured by permanent works. But to these permanent works, constructed in time of peace, will be added other works at the start of hostilities. The material for these latter works will be prepared in time of peace. It is not a question of constructing a line of fortifications which will only allow a rigid, fixed defense, but a series of defensive nucleii, not in the form of fortified cities, but built on the natural strong geographical lines. The present war proves that attack alone gains decisive results and open warfare should be sought for in place of trench warfare. On the other hand the war has shown the great strength which properly disposed fortifications give to a defense. This is especially valuable to us with the central position of Germany.

Command

Tho technical development has made this war absolutely different from any other, still it is absolutely necessary to consider other wars studiously. The moral factor is, in the last analysis, still the deciding one. In so far as the commanders are concerned the mental factor is the one that wins. If the staffs are not acquainted with the events of former wars they are doomed to failure in this one. In war, as in all questions of practical life, a proper medium between theory and practice must be found. Clausewitz says, "Whoever must command in war should acquire from books only the education of his mind. If he seeks complete ideas, in books, if the realities of the moment do not inspire ideas in his own mind, he is doomed to failure. Others will not understand him; the men who think quickly, those who know what they want, will be the first to lose confidence in him."

The teachings of the past must be worked out and applied to present conditions. This is what Moltke did. (The author discusses the manner in which

EUROPEAN WAR—Continued

Moltke, as Chief of the General Staff, applied the lessons of the Napoleonic wars to the war of 1870, also the statements of General von Alvensleben before the battle of Vionville, and Kitchener after the battle of Paardeberg.)

It is noticed, at the beginning of every campaign, that the enemy's projectile is never felt in peace maneuvers.

Closely as instruction may resemble war, the exact conditions of any situation can never be foretold. Instruction only responds to the exigencies of war to a limited extent.

Neither Moltke nor Count Schlieffen could foretell in detail what this war has offered, but they both devoted themselves to preparing the intellects, by study, for the demands of modern war. In 1909 Count Schlieffen prophesied that the modern rifle would cause the extension of fighting lines, and the density on a firing line, including reserves and all arms, would be less than three men per meter of front, as against 10 to 15 men of the old wars. He also said that the 186,000 men of Gravelotte and the 220,000 of Königgratz would be nothing in comparison with the armies of the future.

The transition to the employment of great masses was even greater than generally expected, tho Count Schlieffen realized that this would be the case. A great part of our successes in this war are due to his incessant work in teaching the General Staff and our General Officers to handle masses of men.

His successor, General von Moltke, maintained this instruction, and the western campaign of August, 1914, was started as broadly outlined by Schlieffen.

Even if we did not win a decisive victory and subdue France, we accomplished wonders in reaching the Marne. Because of important considerations the General Staff decided to stop the battle of the Marne and take up a strategic retreat on a new base." I quote the Swiss writer Stegeman, and truly we were not far from victory, but our offensive did not have sufficient force to keep on advancing in an enemy country which was then well under arms.

In 1870 the French had three-fifths the force of the Germans. In 1914 the French forces were a little greater than the total mobilized by Germany, and deducting the forces sent to the eastern front, and those sent to protect the coast, the numerical superiority of the French, Belgian and English was about 750,000 men. It must be kept in mind that at the battle of the Marne four army corps had been detached from the German forces, two were sent to the eastern front and two more remained at Maubeuge and Antwerp.

The phenomenal attrition of forces presents itself here. In 1805 Napoleon crossed the Rhine and the Main with 200,000 men; at Austerlitz he had only 75,000 and at Eylau later his forces were reduced to 60,000. In 1870 our total forces that crossed the frontier numbered 1,147,000 men, but even with these forces the stubborn resistance of the French caused many grave crises. A vigorous offensive launched to destroy the enemy always ended with a realization that there were not enough troops to make the victory sure. Superiority of numbers always assures victory. Superiority in valor, experience, discipline, and above all in commanders, will win battles, but rarely will they win a war. Victories waste away armies slowly, but just as surely as defeats. Thus the German offensive of early September, 1914, in France was not strong enough to destroy the enemy. A double enveloping movement was planned. But our left wing was held up before the fortifications on the eastern frontier, which had been expected to fall as quickly as the Belgian forts. The envelopment of the French left wing was crowned with success up to the heights of Paris, after crossing the Marne, but then a counter envelopment was threatened, and the advance was stopped. The task of the French chiefs was facilitated by the strength of the eastern forts, and the rapid and plentiful means of transportation at hand. The French also had the interior line.

The battle of the Marne proved that warfare, in which millions of combatants were engaged, with modern armaments, was surrounded by strictly new conditions.

The battles of the Vistula and in Galicia in October, 1914, the battle of Lodz and later on, the winter campaign of the Masurian lakes, and the battles around Vilna in the autumn of 1915, all proved that we had enough men to destroy important fractions of the enemy, but not enough to gain the total success that was hoped for. It is possible to envelop an isolated enemy army but it is very difficult to envelop his entire forces. To have done this on the Marne would have required one more field army than we had in echelon on the German right wing. On the eastern front the efficacy of an enveloping movement was very limited due to the great length of the battle line, and to a small but well-located railroad system which permitted the Russians to give ground and reinforce threatened points easily. Our railroad lines were absolutely deficient.

For these reasons the "breaking attack" reappeared and thanks to a powerful heavy artillery it was successful in Galicia, between the Bug and the Vistula rivers, in the breaking of the Russian front at the Narew in the autumn of 1915, and similarly at Tarnopol in 1917. The Serbian and Rumanian campaigns offered analogous phenomena. Success in these cases depended on a previous moral and tactical superiority in the offense, and a corresponding energy in the effect of our arms. As we did not have these conditions in sufficient quantity on the western front, the idea of breaking the enemy's line diminished in importance, and was replaced by the idea of overcoming a sizable sector, and making use of the tactical advantages thus gained to further the operations in general.

The turning or enveloping movement still maintains its strategic and tactical importance. According to Clausewitz, the only way to win a complete victory is by an enveloping attack, or by a battle on a changed front. Schlieffen, who considered it his prime duty to

keep the impulse to annihilate the enemy alive in our army during a long period of peace, lays down the conditions for a "battle of destruction" in his book "Canas." There have been a few cases in this war where a big enveloping movement would have succeeded, notably after the battle of the Marne. If our western enemies had used their railroad lines and automobile columns to send a considerable force against our right flank, they could have prevented us from holding the line of the Aisne and the western Belgian frontier. But as our enemies did not gain a tactical success in the battle of the Marne, they lacked the capacity and strength to make this move; their advance was purely frontal.

The Germans began to take up a partial offensive and in this way subjugated the enemies in their front. We reinforced our right flank and managed to hold it against the great numbers of French sent against us.

The war on the western front became position warfare, and as such, an "active defense," in November, 1914, after the failure of the Iser attack, and after the eastern front had again been reinforced.

The reason that position warfare has assumed such extension and importance on both the eastern and western fronts was because our enemies were unable to break the German and Austrian lines. If the military qualities of the different armies had been the same, this position warfare would have been impossible because the Entente Powers, with their numerical superiority, would have rolled us backwards, and started open warfare once more. They did not succeed in doing this, but on the other hand, the forces of the Central Empires did not succeed in changing the first lines in France from their position at the end of 1914, and the eastern lines from their position in the autumn of 1915. Open warfare was reserved for the Serbian front, and later for the Rumanian front. Since we failed to break thru on the Marne, and on account of our central position, we were reduced to a "limited-offensive." The mere fact that we have preserved our lines in enemy country is an important achievement. For us it became a question of getting ahead of the enemy on isolated occasions, as we did at Verdun, and as the Austrians did in the Venetian Alps, but the initiative on a big scale was left to the enemy. With this, we were obliged to assume a tenacious but passive activity, to preserve and reinforce our trench lines.

In accordance with the points of view up to that time in vogue, on many occasions we allowed the enemy to break thru our front lines, where his heavy artillery had destroyed our trench system and caused us severe losses, afterwards throwing him back with our reserves.

As our enemies became more and more addicted to the use of heavy artillery and bomb-throwers in the preparation for their attack, our defensive battles assumed a new tendency, which is well summed up in the army orders for Apr 11, 1917 which says: "With the present fire, which breaks up the ground so thoroly, a rigid defense is impossible. Fighting is no longer along a line, but thru a deep zone, fortified in echelons. The fighting in the most advanced lines oscillates backwards and forwards, saving the man power at the expense of lost ground and matériel, but inflicting severe casualties on the enemy."

This procedure economized lives and at the same time preserved the morale of the troops, who no longer saw themselves exposed to destructive fire in the trenches with no hope of being saved. Of course, a plentiful supply of ammunition and reserves for the counter-attack was always pre-supposed in these battles. In the defensive battles of 1916-17 on the western front we were short of both these elements on many occasions.

It was not considered desirable to abandon ample sectors to the enemy and then fight a big offensive, merely for the purpose of changing from trench to open warfare. Such counterattacks on a large scale would have obliged us to dominate new enemy works. And if the enemy did not get across the entire line the net result would have been a cumulative abandonment of enemy territory. It is true that our positions were badly located in some places, because they had not been freely chosen, but remained where the enemy advance in the autumn of 1914 had been stopped. But the enemy press made so much of even small inevitable gains that the moral effect of an enemy advance became very great, and even the transitory loss of ground became serious. Besides, the rich and industrial zone of northern France had to be thoroly exploited.

At the end of the winter of 1917 we withdrew some of our front along the Ancre, Somme and the Oise. The general situation had changed, and besides, the retreat was not made until stronger positions in rear had been prepared and manned. The enemy was surprised by this abandonment of our advanced line. Our retreat, which was cleverly carried out, caused heavy enemy losses; we gained time, better security, and we economized our forces.

The principal object of war is a decision by arms; the purpose of battle is to destroy the enemy. Our trench lines have served this purpose. They are not held to insure possession of the enemy territory behind them.

Of course, warfare will vary with the ideas of the leader, provided he has energetic desires.

In the future we must try to maintain open warfare, since this is the only manner of fighting which has brought us decided results in this war. Open warfare of the future will be developed slowly, as it will be influenced by the many and varied weapons of trench warfare which we now have. An approximation to the open warfare of the future was seen in the operations in East Prussia and Lithuania, in the Austro-German offensive of the autumn of 1915 in Poland and Galicia, and in the Serbian, Transylvanian and Rumanian campaigns. The success in Rumania shows how rapidly a campaign may be carried out if the commanders have a firm will to act, and the conditions of troops is such that they can keep the many auxiliary elements of war right up with the firing line. We were well prepared for open warfare and much superior to our enemies. This form of warfare will

EUROPEAN WAR—Continued

continue to be the decisive one. The years that we may have passed in the trenches will not affect its primary importance.

The offensive impulse, which belongs to our armies, will have to be maintained by all means. It has produced great effects in this war, especially in the battles of Flanders and the north of France. But we must admit that at the beginning of the war this desire to attack cost us heavy losses on many occasions. The statement that the spade is the death of the offense is not true. Trenches and fortifications may be offensive as well as defensive. They may be so placed as to oblige an enemy attack. Whoever takes up the defense, where the general situation demands it, is in perfect accord with the most illustrious leaders of history.

War is a continuation of politics with different instruments. The political situation and the condition of international politics brought Germany and her Allies into a war on two frontiers, into a struggle against unheard of difficulties which are constantly growing larger. These facts have given the war a unique character, and have obliged us to be continually economizing our man power. This war resembles the Seven Years' War because in both cases we had the interior lines. If the politics of the future prevents us from being placed in such a menacing condition as we are now, or allow us the freedom to strike formidable and decisive blows at one frontier at a time, then the wars of the future will resemble those of the past.

Therefore, it is planned to maintain the fundamental ideas of war such as they were in the German Army before 1914. These ideas will be amalgamated with the experiences of the present war. These experiences will be carefully studied and the lessons learned infused into our tactical and operative judgment. We can approach perfection only by combining our old system with incessant study.

The art of war requires more than the study of a life time before it is thoroly mastered. This is especially true to-day with our varied and constantly changing armaments. Napoleon said that he had to change his tactics once every ten years in order to maintain superiority. We acted in accordance with this statement before the present war. Our armament was properly developed, our regulations were all new, and adapted to the very latest experiences of war—especially the Russo-Japanese war.

Our instruction proceeded along progressive lines. Our regulations permitted the broad exercise of individual judgment in every case, so that troops could adapt themselves to the effect of modern armament. They have even adapted themselves to the new and undesirable trench warfare. In so far as the details of combat are concerned many new things have been met, but the general orientation of our regulations has not been affected. It has been proven that on all occasions the use of common sense is superior to following out any regulation or form. It cannot be denied that a long period of peace tends to conservatism in an army. Innovations are slow to be adopted. Many fail to see that permanent changes must be developed first, and then accepted. This war has affected the technics of fighting very much, but neither land nor air warfare will ever remain fixed and unchangeable.

Personal experiences will always affect a person's viewpoint, and so it is in this war that officers fighting at different sections, on different fronts, and under very different conditions, have their own ideas as to the best manner of conducting operations. In their manifestations wars often repeat themselves; the form of warfare is the thing that is constantly changing; the essential of war is to adapt its forms to the immediate conditions.

[A Visit to the German Front in Belgium. By Capt. Pedro Maluenda. *La Guerra y su Preparación*, Oct, '17. 15,000 words. Illustrations.]

Permanent Fortifications at Liége and Antwerp

Looking at the fortifications of these places to-day one realizes that the permanent polygonal fort will be used after the war. The Brialmont fort, tho constructed along the most modern lines, does not satisfy the present necessity for invisibility. Concrete and steel were relied upon to make it invulnerable. This cannot be done, for a fort that is shelled is a fort destroyed.

Outer defenses were not developed enough by Brialmont and rapid transportation for the garrison from one point to another was not adequately provided for.

Liége.—Liége was fortified to defend the Meuse River. Its works consisted of 12 forts at from 7 to 9 kilometers from the citadel; there being 6 large forts and 6 small ones. Loncier fort, which is now in ruins, was on the left bank of the river near the Brussels RR. line. It was in flat country. The fort itself was trapezoidal in form with re-entrant angle on the flanks to allow a concentration of fire for close defense Its armament was:

2 cupolas for 21 cm. howitzers.
1 cupola for two 15 cm. rifles.
2 cupolas for two 12 cm. rifles.
4 disappearing turrets for 5.7 rifles.
1 disappearing turret for searchlight.

Embourg fort is south of the citadel between the Oeurthe River and a small tributary. It was plainly visible and easily attacked. Its armament consisted of:

1 cupola, 21 cm. howitzer.
2 cupolas, 15 cm. rifles (2).
1 cupola, 12 cm. rifles (2).
4 disappearing turrets with 5.7 rifles.
1 disappearing turret with searchlight.

The citadel was attacked by six mixed brigades and a strong force of heavy artillery under General von Emmich. The defense consisted of three or four brigades under General Leman.

The siege lasted from the 4th of August until the 15th, when Loncier fort, in which General Leman's headquarters were situated, fell. All other forts surrendered except Chaud-Fontaine, which was blown up by its commander.

The Germans launched a cavalry attack on the Citadel on Aug 4, with the object of capturing General Leman. This was frustrated and then the main attack was started from the east. The 4th Infantry Brigade, under General von Wusson, was the most successful. Gen. von Wusson was killed at Retline. Gen. Ludendorf took command and on the 7th captured the Citadel and cut telephonic connections to all the forts, leaving them isolated.

The Belgian troops retreated to the left bank of the Meuse River without blowing up the railroad bridge, and several other bridges. The Germans then placed their heavy artillery on the maneuver field opposite Herstel and began their bombardment with 15 cm., 21 cm., 30 cm. and 42 cm. mortars. The last fort to fall was Fort Loncier, on Aug 15th.

The Germans were surprised at the effectiveness of the 42 cm. mortar. Three 42 cm. projectiles were fired on Fort Loncier. One was over, the other short, and the third struck the casemates and blew up the arsenal. There were very few survivors. The concrete failed to localize the effect of the explosion, and the cupolas were blown up by interior pressure.

The works were poorly constructed, and the defense was not tenacious or well organized. The Germans suffered a total of 1500 casualties, but captured 2000 prisoners from the Belgians.

Antwerp.—This place was surrounded by a belt of 10 or 12 forts about 6 kms. from the center of the town. All these were old-fashioned works, and were reinforced with 19 new forts of the Brialmont type, with accessory works in the intervals, which comprised a defensive line from 15 to 20 kms. from the center of the city. The total garrison numbered about 100,000 Belgian and English troops. The place was attacked by the 3rd German Reserve Army Corps under General von Besseler. The main attack was delivered from the southwest by the 5th and 6th Reserve Divisions and the Marine Division.

Forts Waelhem and Lierre fell on the 2nd of October, a day after Ft. Wavre St. Catherine had been taken. All these forts were constructed of poor materials, were inadequately armed, and had too much visibility.

With their capture the Germans had a breech of 14 kms. in the outer defensive zone. After several days of bloody fighting in the flooded region of the Nethe River the Germans entered the outer line and, as the inner line of forts could put up no great defense, the city immediately surrendered.

Engineer Services

Roads.—There are plenty of very good roads in Belgium. They are usually surfaced with macadam or paving stone. The engineers are constantly building new roads, and upon their completion they are put under the care of prisoners.

Bridges.—The Germans have retained their pre-war bridge matériel. To each division is attached a ponton section, with sufficient matériel to construct a light bridge 60 meters in length or a heavy bridge 35 meters long. The ponton matériel is carried in 15 wagons. Each army corps has engineer organizations attached to it, and bridge matériel which may be used to supplement that of the divisional ponton section. For infantry advances small hand bridges up to 10 meters in length are provided for crossing narrow obstructions or holes. For passing water-filled holes a metallic float is provided. For muddy ground, simple duck boards with a single rail to serve as a night guide are made in great numbers. Around Dixmude, as well as on the Russian front, these duck boards are laid by kilometers over muddy, boggy ground.

Mining Matériel.—The Ypres salient is the only place on the Belgian front where the Germans use land mines to any extent. The rest of this front is too near water level to permit mining operations. One mine which we saw opened with a gallery at the bottom of a 27 meter shaft. The main gallery was 150 meters long and was under the English line. The main and side galleries were all reinforced with lumber cribbing. I saw curved reinforcements made of corrugated iron on wooden blocks at several of the depots. Gen. Hildeman, Engineer Officer, of the 4th Army, says wood is still used in preference to anything else for cribbing, because it is so easily worked. We also saw many microphones at some of the depots. They are used to detect enemy mining operations.

Field Fortifications.—The principles deduced from the Russo-Japanese and the Balkan wars in general still hold good. Along the front visited, field fortifications are being gradually replaced by semi-permanent works, in order to reinforce the lines, cut down the number of troops necessary to hold them, and give the troops more comforts. The great range of modern guns, the power of modern explosives, and aerial observation have caused strength in construction of works to be subordinated to invisibility as the prime necessity. In the engineer depots we saw sheet iron loopholes and shields made to be placed on a parapet and covered with dirt. Two types of infantry shields are used, the light and the heavy; the former can be dragged along by an advancing infantryman, the latter is placed on the parapet when firing.

Reinforcement for Trench Walls.—The trench revetment generally consists of brush hurdles, tho in some cases planks are used, depending on the nature of the ground. These reinforcements are being continuously built and entire brigades are kept busy repairing the damage done by grenade explosions and rains. The quantity of matériel used to keep trenches in repair is fabulous.

Accessory Defenses.—These are barbed wire entanglements for the most part. In front of the second and third lines, which are generally out of enemy rifle range, the entanglements are built in the usual fashion. Barbed wire is loosely strung between posts which are firmly imbedded in the ground. In front of the first line the work has to be done much more quickly. Here the entanglement forms are prepared beforehand, then rolled out to the line of wire and pegged down with two stakes. These forms are of various kinds. There is a helical iron frome covered with

EUROPEAN WAR—Continued

wire, a cylindrical frame similarly used, and a frame consisting of two steel crosses joined at the centers by a steel rod 5 meters long. Wire is strung from the ends of the crosspieces. It resembles a wired cheval-de-frise.

Masks.—In order to conceal the trenches from enemy airplanes, chicken wire is stretched over the top of the trench and this is covered with branches, sacks and dirt, to resemble the ground. Masks of wire and painted cloth are used to cover battery emplacements. Infantry shelters are covered with steel rails, lumber, and dirt, in variable quantity, depending on the degree of security required.

Semi-Permanent Works.—This will include all concrete construction. These works were built only by the engineer troops at first. Now all troops build concrete shelters for their own purposes.

Infantry Shelters.—There is no regulation plan by which these shelters are constructed. Around Dixmunde, where the mud and water invades every place, these shelters are built of reinforced concrete with casemates for four men, seated or lying down, and a banquette or firing step along the length of the parapet. These places are built in half company lengths and will stand the explosion of any shell under the 21 cm. caliber. The concrete is always thicker than 1.5 meters, and is heavily reinforced with steel.

Machine Gun Forts.—These are plentiful along the second and third trench lines, arranged for crossfire and flanking fire on places where the enemy would advance once the front line had been broken. These little forts are of various sizes and shapes, depending upon their purpose and location, but they are always carefully hidden from aerial observation. They always have interior loopholes for machine guns to fire thru and on the exterior wall there is always a broad fire-step or shelf from which infantry fire can be delivered.

Battery Emplacements.—These are scattered between the second and third lines, or at distances above 2000 meters from the first trench line. Figuring on an effective zone of fire 6000 meters in depth, the emplaced guns still have a "useful" zone of 4000 meters, while still at a safe distance from assault and capture. The English and French build their battery emplacements in nests, while the Germans have theirs more widely scattered. Both systems have their advantages. Each battery has an occupied emplacement and a secondary emplacement to which it can fall back in case of emergency. There are also many dummy emplacements for the purpose of attracting and diverting enemy fire. All German batteries are practically casemated. Casemate construction is strong enough to withstand bombardment from 21 cm. guns and mortars, and in some cases, 24 cm. guns and mortars. The Allies prefer invisibility and mobility for artillery to strongly built semi-permanent emplacements.

In the construction of emplacements, an immense wood and brush screen is first built, and then the forms are made, the cement poured and the work completed under this screen.

Trench Warfare

Hand Grenades.—In January, 1917, hand grenade construction in the German army was standardized and was limited to the handle grenade "Stielgranat" and the ovid grenade "Eigranat." The former is the offensive grenade while the latter is for defensive use. The offensive grenade kills by the power of its explosive gases. As a result its effective zone is very small, and there is no danger to the grenadier who throws it. The grenade and handle are transported separately. The handle is provided with a central tube in which a fulminate primer is placed immediately before the grenade is to be used. The grenade itself contains the explosive charge and a black powder time fuse of 5 seconds. Dummy grenades of the same weight and shape are used for instruction purposes. These are provided with a fuse and primer receptacle so that the soldier can become accustomed to the manner of priming and the 5-second period before explosion.

The ovid grenade kills by the effect of its steel fragments. They are large and heavy and produce disabling wounds. Intrenched troops make use of the ovid grenade as they are easier to throw from a trench and the parapet protects the throwers from flying pieces. The grenade is not much larger than a hen's egg. It is charged with quick burning black powder. It contains a black powder time fuse and a friction primer which is operated by pulling a short wire. The soldier wears a breast plate in which is placed a hook so he can prime and throw his grenades with one hand by catching the primer wire on the breast plate hook and pulling it out of the grenade. Grenades and primers are kept separated until they are to be used.

There is also a large heavy grenade thrown by mechanical means. This has the destructive power of a 75 mm. shell. This grenade cannot be fired very accurately. The mechanical thrower is laid approximately in altitude and azimuth on a given target.

Lachrymose Gas Grenades.—These are spherical, about 9 cms. in diameter and divided into two parts by a steel diaphragm. The explosive charge of black powder is in one part and the gas, Ethylbromide, in the other. They are used in attack when the wind is favorable.

Gas Masks.—These protect the eyes, nose and mouth from the effects of gases. They are made of air-proofed cloth and the breath is taken in thru a cylindrical canister and expelled thru a valve. They must fit the face perfectly. They are carried in a tin can slung around the neck.

Smoke Grenades.—As the name indicates, the object of these grenades is to make a cloud of smoke which will impede the enemy's vision. In construction and size they are about the same as the gas grenades. In some of the depots we saw some cylindrical containers about 1 meter long by 40 cm. in diameter which contained a second cylinder and a sphere filled

with certain chemicals which upon being mixed produced a dense smoke. These cylinders are used in the trenches and are not carried by assaulting troops.

Bomb-throwers.—These machines are built to throw great quantities of high explosives over short distances (under 1000 meters), for destroying trenches. They include all sorts of trench mortars, and the models are constantly changing. At the supply shops at Ghent we saw 700 of one simple model made in a very short time for the 4th Field Army. The most modern models have a recoil mechanism and trail the same as a field piece and are provided with optical sighting devices. They are all muzzle loaders and the barrels are rifled. The propelling charge is a powder in disc form which burns laterally. There are three calibers—25 cm., 17 cm., and 7.7 cm. The maximum rate of fire with these is 20 rounds per minute, and the ranges are 600, 700 and 1000 meters respectively. The bomb thrown by the 25 cm. mortars is 70 cms. long and weighs 100 kgs. These mortars are mounted on wheel bases.

Flame Thrower.—Used chiefly to burn wooden construction in trenches and make them uninhabitable as well as to burn out covered communication trenches. The flame thrower squad consists of three men, one carrying the flame thrower and a regulating key. The other two carrying the combustible ingredients in pouches. The flame is bright red, gives off a dense black smoke, and the flame stream is between 8 and 10 meters long.

Signal Pistols.—These are breech loaders, about 3 cms. in caliber and the shells are center-fired. The cartridges are 7 cm. long and throw the signal bombs to a height of 150 meters.

Battalion Artillery.—This small caliber artillery is used to support an infantry attack. Each attacking battalion has 4 pieces, not organized as a battery, however. Each piece protects the advance in its own sector. The caliber of these pieces is 7.63 cms. and they only fire a percussion fuse projectile.

Mounted Rifles.—These are used to cover observation posts, entrances in the wire entanglements and other important points both day and night. They have rapidity of fire, accuracy, and are of such a caliber that they can be easily supplied.

German soldiers carry a sharp trench knife and a steel mace for hand-to-hand fighting. The knife is 40 cms. long and is a very eff ctive weapon.

Employment of New Equipment.—We saw the new equipment demonstrated at Audenarde, near Ghent, where the Germans have an instruction school and an assault battalion, which is organized and used for instruction purposes. We were guests of Gen. von Schickfuss, the Inspector General. The assault battalion is commanded by a captain, which is not unusual, and the course of instruction lasts 15 days. The class included 50 officers from various regiments at the front.

The uniforms of the assault battalion consisted of a steel helmet, an ordinary blouse, breeches reinforced at the seat and knees with leather, heavy boots. The individual equipment consisted of a carbine slung over the back, a gas mask, two water bottles, a bread can, two pouches each containing 8 hand grenades, a spade 60 cms. long, wire cutters, and 60 rounds for the rifle distributed in the blouse and breeches pockets. The helmet is 2 cms. thick. It is effective against shrapnel, and in some cases against rifle bullets, and lessens the effect of exploding hand grenades. The water and bread ration is very necessary as troops are often cut off from supplies for two and three days.

The use of the hand grenade requires careful training as it is a dangerous weapon to handle. The recruit is first taught to throw the grenade about 30 meters, then to give it the proper trajectory so it will go down into a trench, and then they are taught to hold the grenade while counting 21, 22, 23, in German, before throwing it. They then lie flat on the ground until after the explosion. The grenade is in the air about two seconds so that by counting it explodes almost on impact. Heavy wire screens are provided for protection against enemy grenades. These are in a frame which is placed on the edge of the trench and inclined to the rear.

In order to destroy accessory defenses, squads of 7 or 8 men are detached opposite the object—say an entanglement—to be destroyed. These men are covered by a nearby trench or sap. They take advantage of the ground for protection and throw smoke grenades until a good cloud has been laid down. Then they open fire with handle grenades on the opposite trench while one man sneaks up and places a charge of high explosive, or cuts the wire with his nippers. These explosive charges consist many times of 10 handle grenades bound together.

Trench Fighting.—When an assaulting group enters an enemy trench a signal rocket is immediately sent up, and the artillery lengthens its range. The fight in the trench then takes place; trench knives and flame throwers come into play. As soon as a section of trench is taken it is organized for defense. Assault squads of seven men each then move up the communication trenches to clear them out and attack the succeeding lines. These assault squads consist of a leader who is in front, armed with a rifle, two grenadiers following the leader at a proper distance, and then two grenade carriers, who are in turn followed by two riflemen. The distances between pairs is such that one grenade explosion could not kill more than two men. The leader uses his rifle against any defenders who escape the hand grenades, and at the same time raises a signal to show the point reached by the advance so the battalion artillery can keep 40 to 50 meters ahead of the assault. The two riflemen in rear protect the flanks, and aid the advance. As each new line is taken a colored light is sent up, and as soon as captured trenches are reorganized a red signal is put up so the advanced assault columns will know where to fall back in case of necessity.

Lines of Communication

Belgium has always had a dense network of railroads because the country is flat and very rich indus-

EUROPEAN WAR—Continued

trially. The Germans have exploited these railroads to the limit.

The lines are of three gauges, the International gauge for main lines, the 1-meter gauge for secondary lines, and the narrow gauge lines, which run up to the trenches. Railroad stations have been enlarged and great warehouses built to care for the exigencies of military traffic.

The international gauge roads carry matériel and personnel from the interior of Germany to the supply centers behind the lines. The 1-meter gauge lines are laid along wagon roads and run from these supply centers to about 4 kilometers behind the front line. They are built out in all directions from the international gauge terminals, and stations and loading platforms are arranged so that direct loading and unloading can be done from the main lines to the 1-meter lines.

The narrow gauge is about 60 centimeters wide and in general it supplies batteries and trenches. In some sectors small armored gas engines furnish the motive power, but ordinarily men or horses do this work. The narrow guage tracks consist of parallel 2"x4" or 2"x6" lumber, with square iron on the interior edge. These narrow gauge roads are controlled exclusively by the regimental commanders. The 1-meter roads are controlled by a captain of engineers.

There are two types of military railroad bridges, the Schultz bridge and the Lubbecke bridge. The former is used for the 1-meter gauge roads, the latter for the main lines. They can span up to 60 meters.

Canals.—The Germans are making use of all the fine canals of Belgium for military purposes. The canal system is notably developed around Antwerp, Brussels and Ghent. The Germans are deepening the Brussels-Antwerp canal so that sea-going vessels of 2000 tons can go directly to Brussels.

Automobile Transportation.—This service is in the hands of special troops and includes light and heavy mechanical transportation. All types and makes of cars are used so that it is very difficult to make repairs.

Rubber tires have been replaced by steel spring tires, laminated wood and steel tires, and various other mechanical substitutes which are entirely unsatisfactory. The velocity of automobiles has been greatly reduced by this lack of rubber, especially in winter when the roads are frozen hard.

Factories have been established in Germany for the rejuvenation of old rubber. The contents are broken up by the use of chemicals and 8 per cent new rubber gum added.

Organization.—Each division has a truck train of 9 trucks and each army corps an additional train of 17 trucks. These are only used to carry divisional and army corps impedimenta, and to transport materials for construction to the front. They are generally Benz trucks. Some are provided with slings for carrying wounded.

Telegraphy and Telephones.—These are organized according to modern ideas accepted before the war. Electrical communications by wire are confined solely to telephones and they belong either to the infantry or artillery. Hence there are two telephonic systems.

The German engineer troops are divided into "sappers" and communication troops. The latter are noncombatants and devote themselves exclusively to the construction, maintenance and operation of lines of communication.

The big telephone supply station is in Ghent where we saw, besides the usual civil and military telephone equipment, microphones, patrol telephones that carry the sound of a whisper, artillery, infantry and engineer telephones, underground cable, and all sorts of telephone wire.

The telephone communication on the front is excellent. Every point is connected laterally and to the rear by several means, besides the telephone.

Radio Telegraphy.—This system has played a secondary part in trench warfare. It is used chiefly to gather enemy messages, to communicate with airships. and as a reserve in case the telephone is interrupted.

Visual Telegraphy.—The heliograph is not used to any extent. Smoke and light bombs are extensively used. At night a special light projector, or searchlight, is used. Each company has a small portable acetylene searchlight with a 25 cm. projector.

In the first lines a simple electric light with an interrupting key is used for sending. A lens is provided to focus the rays on any point. A special prismatic trench periscope is used on the receiving end. The range of these instruments is from two to three kilometers. There is a second type which ranges up to six kilometers.

Acoustic Signals.—These consist of iron gongs, sirens, and drums. They are used when noise prevents other signals from being heard.

Carrier Pigeons.—Pigeons are used by troops on every front. They are also used extensively to carry messages from spies.

Aviation

We visited two aviation fields, one in the supply zone. which was an instruction field as well as a supply depot for active air squadrons at the front.

The second one was 10 kilometers from the front lines and the machines were all the fast combat type. There were five squadrons in rear of one army corps.

One of the aviation camps visited was ideally situated on a big plain. Railroad lines ran into the camp, and it was provided with a wireless receiving station, hangars, repair shops, and store houses, all of permanent construction.

Another field was small, and the buildings were made of lumber. Small repair shops for airplanes and machine guns were also of semi-permanent construction. Hangars were built for 18 planes.

The Germans have a transportable hangar constructed of lumber. It is made to house two machines and is built in two sizes, one for light fighting machines and the other for battle and bombarding planes. (The author includes a plan and profile of these hangars.) The hangars are built in Ghent by government contract. at a price of 7000 marks. When we were at the

front 130 large type and 30 small type hangars were already in use.

Airplanes.—We only saw the reconnaissance and pursuit planes, both single and double seaters. Observation planes are mostly the L. V. G. (Luft Verkehr Gesellschaft) make, and Albatros type, with a Mercédès, Benz, or Opel motor.

The L. V. G. model is a tractor biplane, with lateral overhang in the upper wing, and lateral ailerons on both wings to increase the sensitiveness of the plane to horizontal controls. Motors are 160, 180, and 220 h.p. and a maximum speed of 200 kms. per hr. can be reached on a descent.

The pursuit planes of the latest model are the Albatros type with a 160 h.p. motor. They carry two machine guns fixed on parallel axes. The plane, completely equipped, weighs 700 kgs. It has a climbing power of 3000 meters in 7 minutes and 5500 in 20. It is a very flexible and easily handled machine. It can turn on a radius of 5 meters without losing much altitude. This type is better than the Taube or Fokker. The strongest part of the newest models is the upper wing. The lower wing is in two parts, fastened to the fuselage which practically hangs to the upper wing. There are no wire braces under the lower wing.

The machine guns of the Albatros may be fired singly or simultaneously. Both fire thru the propeller—one round at every second revolution. They are fired mechanically. They are pointed by means of a front sight on the machine gun and a mark on the wind shield. Each machine gun has 1000 rounds of ammunition.

Reconnaissance planes carry one machine gun operated by the observer.

The aero-cameras are of two types—Goerz and Zeiss. (Both are explained by figures.)

Aerial bombs are either explosive or incendiary. The former weigh 12.5 kilos, the latter 20 kilos. Both kinds are cigar shaped with fins on the back end to insure vertical fall and proper fuse action. Explosive bombs are of a steel gray color and about 8 by 40 cms. Incendiary bombs are black and slightly larger than the explosive ones. They burn about 15 minutes, throwing off great heat, flame and smoke.

The use of colored signal bombs from airplanes is very general for signals between friendly planes or for correcting artillery fire. They are fired from a 3 cm. caliber pistol.

Night landings are made by firing light bombs of great intensity from the field, which illuminate the entire neighborhood. The lee side of the field is marked by two white lights and one red light placed laterally.

Hydroplanes

The most common models are the Albatros and L. V. G. They are of practically the same construction as the land machine except for the landing gears. In one Albatros type a strut system has been invented which eliminates the need for wire bracing between wings.

Defense Against Airplanes

Anti-aircraft firing is done by battery with shrapnel. Lateral observation is preferred in figuring firing data. To protect against air raids in the towns, openings have been made directly from the streets to the cellars, and a sign posted outside the opening showing location and capacity of the cellar. Street lighting in the zones of operation and supply has been forbidden.

Reinforced concrete bomb-proofs are constructed at railway stations and at important places in the open country.

Construction

Soldiers' Quarters.—There are various models but all are of analogous form. The older type was unceiled and had windows on only one side with doors at each end. They were very cold in winter. The new form is ceiled, and the room is divided into two parts—bedroom and lounging room. There is also a better window arrangement.

These barracks are made of wood thruout. They are constructed in parts, and all parts are numbered so that they can be taken down and put up rapidly. These barracks, too, are very cold.

(The barrack construction is illustrated by plans, profiles and photographs.)

Officers' Quarters.—The typical set of quarters for officers and two orderlies. It consists of four large alcoves and a dining room. (Illustrated by plan.)

Stables.—Stables are built for 48 or 32 horses. (Illustrated by plan and elevation.)

Ammunition Storehouses.—The construction of these buildings is similar to that of the barracks except that the floor is elevated and a platform is provided for loading and unloading. They are always along a railroad line. They never exceed 25 meters in length or breadth—a small storehouse being desired in order to limit the effect of an explosion.

These buildings are at a distance of from 100 to 200 meters from each other with a bomb-proof wall between them. Each building is electrically lighted, has lightning rods, gutters and drains, and water barrels and sand boxes to be used in case of fire.

Miscellaneous Material.—Latrine seats of the usual type are constructed and used extensively.

Fifteen-ton scows are built for use on canals, and in the rainy season over inundated country.

Great quantities of reinforced concrete blocks, 10.6 by 9.5 cms., are built for construction purposes in the front line trenches.

Water and Lighting Systems.—As the water in this war zone is as a rule contaminated, a water system has been built to supply the needs of the 4th Army. A reservoir has been built at a high point in rear of the lines, and water pumped into it from nearby wells and springs. From here it is piped off to the various camps, and in the case of two divisions, almost to the front line trenches. Water wagons carry the water from the end of the pipe lines to the front lines.

Electricity is used to light storehouses, barracks, underground shelters, battery emplacements, etc., and many power plants have been built to furnish the necessary energy. In the front line trenches acetylene lamps are used to a great extent.

EUROPEAN WAR—Continued

Electrical Enclosure Fences.—In order to prevent passage between Holland and Belgium a wire fence, electrically charged, has been built by the army of occupation along the entire frontier.

This fence is built on a single line of 2-meter posts, with six strands of wire (two barbed) hung on insulators. The regular fence posts are replaced by a pole every so often which carries the feed wire and an electric light. The six wires are constantly charged with a 2000-volt current. There is a seventh wire near the ground which is ordinarily not charged but the moment this wire is touched it charges automatically.

Light protecting fences are placed at each side of the charged fence in order to prevent accidents.

To complete the system a second wire fence has been built 80 meters from the main one, thus forming an 80-meter dead zone. Placed every 100 meters along the line are sentinels, who fire without warning on anybody in the dead zone.

[Evolution in the Methods of Making War. By Major T. E. Compton. *United Service Mag.*, Mar, '18. 7000 words.]

I

Three months of war of movement and three years of trench warfare establish the latter as the predominant form of modern warfare. Some officers have risen to field rank knowing no other type. In the part of the Hindenburg line southwest of Cambrai, recently (November, 1917) captured, we read of a bomb-proof tunnel thirteen miles long, lighted by electricity.

At the outbreak of the war, all anticipated a war of movement. The German strategy contemplated a short war. So the trench warfare surprised the whole world, and the late Jean Bloch, who died in Warsaw in 1901, was the only writer of note who foresaw it. He wrote, "The next war will be a struggle carried on behind fortified positions, and for that reason will be very long." Forecasting the future character of warfare, he wrote, "The war will consist of a series of combats for the conquest, or the defense, of fortified positions, which will spring up everywhere, wherever it is possible to establish them."

The teaching of the war schools did not foresee the whole effect of numbers combined with fortifications, but the great defensive strength of lines provided with guns, rifles, and machine guns was recognized. Maneuver by the flanks was taught as a necessity, and the lines were prolonged in 1914 until they rested on the sea and on neutral territory to avoid flank attacks. That line has remained with but few modifications in trace, and the operations have taken on the character of a siege. Yet the Eastern front in 1915, Mesopotamia, and more recently Palestine and Italy, serve as a reminder that the stationary warfare of the Western front is in great measure an accidental method of making war.

If the principle of the nation in arms with the great armies that result therefrom have come to stay, then trench warfare may be accepted as the dominant future type. Nowhere in Europe is there a theater that can not be barred by an entrenched front adequately guarded by the numbers which can be put in the field by the Great Powers under the system of universal service. This may not be true of small nations, as in the Balkan Wars, where the theater was large in proportion to the number of troops engaged.

Numbers, combined with the defensive strength possible thru modern armament and barbed wire, mark a change in strategy as far-reaching as that caused in tactics by the airplane. Instead of a retarding force on one front while operations are proceeding on another, we now find a continuous fortified line. This line can be sufficiently manned without making too serious an inroad into the strength of the total forces available. Thus Germany could oppose a continuous line to the allies on the western front while prosecuting operations against Russia, without the abandonment of territory that would have been necessary under the old scheme of a retarding force. The early victory at Tannenberg made possible the completion of the fortified line on the western front, after the attempt to break thru at Ypres had failed. Thereafter this line was held while the concentration was made against Russia in Galicia. The holding in check of the combined strength of France, England, and Belgium while Serbia was crushed and the Russians driven back to the Dvina was an event undreamed of by the most alert students of the military art.

The correct method of operation for the Allies was a simultaneous offensive on all the fronts, but the difficulties of multiple control were too great to be surmounted. Since November, 1914, the enemy has been on the defensive on the western front with the two exceptions of the second battle of Ypres in April, 1915, and the great attack on Verdun. The main cause of the development of trench warfare has been *numbers,* allowing the defensive front to become continuous between the sea and the Swiss frontier.

II

Clausewitz stands best the test of time as an authority on the art of war, being sound on principles and profound in analysis. He dismisses the subject of strategical maneuver briefly because in his opinion the subject cannot be reduced to rules. He says, however, that there are certain general principles which theory should take into account.

It is proposed to consider these principles briefly, in the light of modern developments, summarized under the headings—

Inventions, *facilitating*—
- (a) *Movement and supply;*
- (b) *Communication of orders, reports, etc.*

Armament, *including tanks and aerial machines for attack of troops and positions, and the destruction of material.*

Numbers, *due to the now universal system of the nation in arms.*

The great fundamental principles of the conduct of war, which have not changed and cannot change, are: (a) moral factors, other things being equal, outweigh material; (b) force should be concentrated at the

decisive point; and (c) every army should cover its communications.

For Germany, the decisive point is Great Britain, on account of her navy. For the Allies, the decisive point is Germany.

Gravelette and Novara are cited as examples of armies not covering their lines of communication. Lord French, in his retreat from Mons, changed his base from Havre to St. Nazaire in order to cover his communications.

These three fundamental principles are obviously independent of inventions, armament, or numbers. Surprise is still an important element of success, but decisive success can only be achieved by breaking the front or by turning the flank or flanks.

Gen. Percin maintains (*La Grande Revue,* June, 1917) that the present war of trenches is not a revolution in tactics, but is due to the mistake of the French in not attacking at all costs. He regards trench warfare as an accidental condition which will rarely occur. But under the present military system and with the numbers resulting, trench warfare has every likelihood of recurring.

Two of Napoleon's principles—that there should be only one army (on each side) in one theater of operations; and that the first objective of a campaign should be the enemy's principal army—are obviously inapplicable with present-day numbers. So also is Clausewitz's declaration that the object of military operations is the annihilation of the organized forces of the enemy. However, these principles remain true in spirit, tho changed in letter. (Reference is made to the operations in East Africa to show that operations were indecisive until directed against the main force under von Lettow-Vorbeck; to the invasion of Austria in 1866 and of Rumania to show that railroads and telegraphs have served to unify the movements of troops even when following divergent lines; to the Rumanian campaign to show the effect of heavy artillery in the destruction and penetration of entrenched positions; and to the Russo-Japanese war to show that the Japanese avoided fortified positions by passing around by the flanks.)

It never seems to have occurred to anyone that the whole of a strategical front might be entrenched and thus leave no flanks. Yet this is what has happened and may continue to happen under the nation-in-arms system. We may see frontiers prepared in time of peace with a continuous line of defense, a revival from the remote past, but changed in detail to low parapets, subterranean caverns, and probably wide ditches to stop tanks. These engines would require a special obstacle, as a ditch with concrete scarps, to be bridged for infantry and provided with suitable passages for the other arms.

[The Warfare of To-day. By Lt. Col. Paul Azan. *National Service,* Feb-Mar, '18. 3000 words.]

(In Two Parts—Part I)

(A reproduction of the first chapter of, "The Warfare of To-day." Houghton, Mifflin Co.)

The principal innovations in warfare of to-day, according to popular nation, are the use of trenches, the employment of huge quantities of artillery and ammunition, and the many uses of airplanes. But the change is even greater. Primarily it is a war of nations; tactically it is a war of positions; it is also a war of matériel, a war of attrition, a war without pity.

The present war is waged by entire nations. The original mobilizations did not take this fully into account, except for the railroads, the use of which for war purposes was foreseen and provided for. But the mobilization swept in many men from factories and industries of vital importance to the prosecution of the war. These men had to be restored to their places, and all must serve where their services will be most useful. The greatest opportunity for women in war is in replacing men in all possible positions, so that more men may be sent to the front; for the important problem is to win, and thus end the war.

Surprise at the employment of trenches and of artillery might have been avoided by a careful study of recent campaigns. Trenches were used in the American Civil War, in the Boer War, and in the Russo-Japanese War. The latter also demonstrated the murderous efficiency of artillery. These lessons were all emphasized by the Balkan Wars. Other developments might have been foreseen. The author has been advocating infantry cannon for thirteen years, more particularly during the past two years.

In the war game training of officers, operations corresponding to a war of movement were studied. The engineers appeared but little, to fortify a village or build a bridge. Professional soldiers wandered in a land of fancies and theories, and after three years some still expect a return to a war of movement. When the war of movement reappears, the war will be virtually over.

This war is a war of *positions.* The front is organized as a series of positions or centers of resistance, linked together to form a continuous front. It is also continuous in depth so as to offer a succession of positions to retire to in case the front line positions must be evacuated. The rear positions are less completely organized than the front position.

How shall an army so entrenched be destroyed? First a number of positions, contiguous both laterally and in depth, must be conquered. Penetration will threaten contiguous positions in flank or rear and thus cause their abandonment. While thus abandoning one set of positions and moving back to occupy a new set in rear the war of movement will occur. If there are no rear positions, the war of movement may continue, but such a condition will, in the author's judgment, mark the end of the struggle.

Movement is limited by the ability to move the artillery, because a forward movement into hostile territory without accompanying artillery, including heavy pieces, would court disaster.

Victory may be sought by attacking in a single zone, but heretofore the defense has always been able to bring up sufficient reserves to stop the attack. An attack over the whole front has been impracticable because it has been impossible to provide sufficient guns and ammunition for the artillery preparation.

The present war is, much more than any preceding

EUROPEAN WAR—Continued

war, a war of matériel. Enormous supplies of guns, munitions and machines, are required, with equal demands upon the factories and transportation facilities.

Finally, it is a war of attrition. Attrition in men is irreparable. Attrition in matériel can be offset by increased activity in manufacture. A shortage of labor or of raw material might result in a catastrophe.

In one sense a war of matériel and of attrition, the war is also a war of *positions* rather than *trenches.* The attempt is always to force the enemy from one position to another.

[The German Army from Within. *Army & Navy Jour.*, May 4, '18. 1150 words.]

The Deputy Chief of the German Imperial Staff, Lieut.-Gen. Von Freytag-Loringhoven, in his book, "Deductions from the World War," says the "frontal wearing down of forces in entrenched warfare has taken place on most sections of the front; but we have reaped positive results only from the war of movement. . . . The expenditure of milliards would be sure to have been avoided if we had succeeded in conducting the attack on a large scale against the front and both flanks of the enemy and in developing it to a sweeping victory. We did, in fact, achieve local victories of this nature, but we did not achieve such a victory at the Marne wtih our whole western army at the beginning of the war. . . . We may confidently assert that a complete German victory at the Marne would have given quite another character to the whole war, and would certainly have shortened it very considerably. From this may be seen the full significance of a decisive military success even in a war so influenced by world economics as the present." Of the Russian army he writes that the country "was not really ripe for universal military service" at the outbreak of the present war, adding, "had it been otherwise we and our allies might have been unable to defend ourselves against envelopment by overwhelmingly superior numbers." In describing the development of the airplane he says: "The French at a very early stage accustomed themselves to the use of aircraft for observation, a plan which has since been imitated by us with constantly increasing success." As to the battle of Verdun and its logic he says: "Even the powerful enectiveness of our heavy and heaviest artillery did not avail at Verdun to enable us to take the works everywhere by storm in the further course of the attack, a proof that skilfully constructed sunk fortifications, when they are favored by the character of the ground, now as ever may be of great value." If the German engineers apply this lesson to a fortress like Metz one may easily imagine the task before the Allied armies in endeavoring to take such a place.

General von Freytag-Loringhoven definitely confirms Allied military opinion as to the purpose of the German General Staff regarding the French army at the beginning of the war. He writes: "The intention was to effect an envelopment from two sides. The envelopment by the left wing of the (German) army was, however, brought to a standstill before the fortifications of the French eastern frontier, which, in view of the prompt successes achieved against the Belgian fortifications, it had been hoped to overcome. . . . The defensive tactics of the leaders of the French army were rendered very much easier owing to the strong support which the fortifications on the eastern frontier gave to their wing. . . . At the same time, even apart from this, it was proved on the Marne that the age of armies numbering millions, with their improved armament and the widely extended fronts which they necessitate, engenders very special conditions. . . . Forces which suffice to achieve victory and even to destroy strong sections of the enemy's forces prove inadequate for the attainment of the complete success which is desired." And he adds that to achieve a complete success at the Marne "we should have required yet another army disposed in échelon behind right German wing." The logic of these statements is that the German General Staff does miscalculate and that Germany has not been as successful in a military sense as she desired.

As to the German aim at a "break thru," he writes that "the preliminary condition of success was always a moral and tactical superiority on the side of the attacker, and a corresponding violence of mass effect. The fact that we did not possess this moral and tactical superiority in sufficient measure in the west has always relegated to the background the idea of breaking thru the enemy front." Possibly the German General Staff are of the opinion they had this double superiority before they began the present offensive. General von Freytag-Loringhoven admits that in the maintenance by the Germans of their defensive since the Marne "we were obliged, as a whole, to leave the initiative to the enemy."

This work is of extraordinary importance and value to military students and the writer's analysis of the Germany army in the future is a phase of his text which shows the mistakes the Germans have made in the recent and distant past in the training of their armies. In that chapter he confesses that after the first drive in the beginning of the war the German army was decidedly short of officers, a fact that we do not recall has been made public before this.

[French Learned New War Tactics at Great Cost in Human Life. By Maj. L. C. Eckenfelder, French Army. *National Service,* Apr, '18. 1100 words.]

The men of the National Army are splendid soldiers physically, and their intelligence enables them to learn quickly the use of the different weapons.

Napoleon said that tactics changed every ten years, but now they change every ten months due to constant improvements in methods. The French started out to use the old tactics of open warfare at the beginning of the war and suffered heavily from the German machine guns.

The statement is heard that the French and British are using trench warfare because they are untrained in open warfare. The truth is that modern weapons have made of this war a war of positions.

"Forget Napoleon, Frederick the Great, Cæsar and even Xenophon, but don't forget that quick-firing and long-range artillery, machine guns, airplanes, tanks, ar-

mored cars, and gas shelling have changed the tactics of open warfare."

[The Warfare of To-day. By Lt.-Col. Paul Azan. *National Service*, Apr, '18. 1800 words]

(In Two Parts—Part II)

A doctrine of modern war has gradually crystallized in the Allied armies in the form of numerous official regulations. A step toward a synopsis of these regulations has been made in the French army in the "Manual du chef de section," which has been translated for the benefit of the American Army.

General von Bulow has drawn up a resumé of the essential principles of the war of positions. This was published in *L'Illustration* for Sept 1, 1917, and it agrees closely with the author's published views on the same subject.

The Germans have impressed upon this war the characteristics of inhumanity and cruelty. These characteristics have been absent from the wars of modern times. In the Middle Ages, in the Napoleonic Wars, and even in the Franco-Prussian War, the hardships of war have been kept within reasonable bounds. All recent agreements have been thrown to the winds.

In these vital moral questions the present war has been differentiated from previous wars. More than any other nation, France has suffered from these barbarities, but the soul of France remains and it will survive.

[Visit to the German Front in Belgium. By Capt. Gluer y Lobatón. *La Guerra y su Preparacion*, Jan, '18. 5000 words.]

The Assault Battalions

The "Sturmbattalion" is a distinct tactical unit and as such special regulations are required for its proper operation. We attended a lecture, given by a German officer to about 60 student officers in which the various methods of attack used by the "Sturmbattalion," as well as those used by the enemy were brought out. The Sturmbattalion is divided into four elements, two infantry companies, one battery of artillery and one machine gun, mine thrower and etc. company. The object of this battalion is to enter into action at a decisive moment in the combat, and then to be withdrawn from the battle line the moment the objective is obtained and its presence is no longer indispensable. The reason for this last is because the assault battalion is made up of picked men and should not be subjected to excessive losses.

In the battalion a great point was made of individual instruction of the soldier not only in the various methods of fighting but in the use of all the equipment issued to the battalion.

The following were noted after witnessing various drills by the assault troops. All exercises were done with ball ammunition and loaded grenades.

In order to advance on an enemy trench which has already been partially occupied by a platoon, this platoon is divided into two groups of four men. The men in the first group march as follows: the leader throwing hand grenades—first from the 16 he carries in his own two bags, and later from the two bags carried by the two men who follow him. These next two men are simply grenade carriers, each one carrying 32 grenades divided equally in four bags. The fourth man is armed with a rifle and protects the leading grenade thrower from any individual who may be left alive in some corner of the trench being carried. One of the grenade carriers has a small flag which he holds up above the trench at frequent intervals so as to indicate to the rest of the friendly force to what point the advance has been made. This latter is very important as the entire success of the advance depends upon an intelligent liaison between various elements, especially between the assault troops and their artillery. Any misunderstanding or confusion may cause terrific losses and total failure.

The second group of 4 men follow the first group in support and enter into action when the first 4 have exhausted their ammunition or when fatigue has incapacitated them.

The attack of one trench from another by hand grenades is made very difficult by the placing of a wire netting above or in front of the trench being attacked. It is very difficult to destroy this netting by artillery fire, and special grenades supplied with a large number of hooks on the outer surface are used. The grenade hangs in the netting and explodes thus tearing a hole in the wire so that the succeeding grenades may be thrown thru without much difficulty.

Hand grenades are also used to open breaches in the wire entanglements. In this case 8 or 10 hand grenades are bound firmly end to end on a board and a wire or string is attached to the friction primer of one grenade. Under cover of darkness or of a small attack this board is fastened under the wire at the place where the breach is to be made—the man who locates it then retires to his own trench carrying the friction wire or string. The friction wire is pulled from the trench and one grenade explodes; the other 7 or 9, as the case may be, are detonated by this explosion and the breach is made. The troops then attack moving thru the breach and throwing hand grenades, being protected by another group who are also throwing hand grenades.

A section of mine throwers fired at a range of 300 meters with excellent results. The mine throwers resemble the modern mortar. They are of 7.45 cm. caliber, provided with recoil mechanism, brake, sighting apparatus and rifled bore. They are muzzle loaders. The powder charge is carried in 2-wheel carts in disk form.

Each cart is hauled by two men. Each mine thrower has a crew of 8 men including the chief of section. Two men handle the gun and the rest act as ammunition and powder carriers. The mines are carried in boxes similar to the cases for the field gun ammunition.

These guns are fired with lightning like rapidity. The mine is dropped down the muzzle and is fired instantly it hits the powder charge. One man was thrown several yards and slightly wounded by the force of the explosion—he was replaced immediately and the drill never stopped.

Such a drill would, of course, be impossible in time

EUROPEAN WAR—Continued

of peace, but in time of war casualties at drill are expected, as troops must be made familiar with actual battle conditions in all instruction.

Flame throwers are used to "clean up" a trench. Two men operate a flame thrower. Both are provided with masks to protect them from the great heat which is caused by petroleum under high pressure. The intensity of the flame is controlled by turning a simple valve. The flame can be thrown 20 meters. Its effect is terrific.

The artillery of the battalion includes a battery of 4 short dismountable cannon of 7.63 cm. caliber. In an exhibition of a combined attack the accuracy of fire of this battalion artillery was astonishing. They placed their shells invariably at from 50 to 60 meters ahead of the advancing infantry. The gunners were guided by the flags and luminous signals shown at frequent intervals by the infantry. In this exhibition the battalion artillery fired at ranges between 200 and 1500 meters from a position behind some trees. Each gun protects a certain infantry group. Each gun was served by 8 men, each of whom carried a carbine slung over the shoulder. The maneuvers of moving into position were all made by carrying the piece by hand. Once on the road the limber for each gun comes up, the gun is hooked on and dragged away. Each gun is pulled by 2 horses and each limber holds 18 rounds of ammunition in three rows of 6 shells each.

Artillery Command During the Course of the War

At the beginning of the war a brigadier general commanded the brigade of field artillery which formed part of each division. It soon became necessary to equip divisions with heavy matériel as follows: A regiment consisting of two groups of mortars—one of light 10.5 cm. caliber, the other of 15 cm. caliber, all under a colonel. Later on the necessity for heavy guns was increased and the regiment was enlarged to a brigade of heavy artillery under a general officer. The matériel of each brigade of heavy artillery varied according to the sector in which the brigade was used—usually it was made up of guns dismounted from permanent forts in Germany and of pieces captured from the enemy.

The command of the two brigades of artillery was usually kept separate. Each brigadier general interested himself only in his own peculiar duties, under the direction of the division commander.

On the Somme, however, the brigadier general commanding the field artillery directed the heavy artillery also.

In a few other cases the brigades of artillery were broken up into groups of guns and batteries, and received their firing commands from the commanding officers of the regiments that they were supporting.

At Verdun the great concentration of guns and ammunition made it necessary to place all artillery under the corps artillery commander during the months of preparation. When the attack was actually launched the artillery brigade commanders took control of their respective units, leaving only the very heavy calibered guns under orders of the corps artillery commander.

The Post of Command of the ——th Army Corps Artillery

There were a great number of maps of the front, made to different scales, hung like curtains, before the artillery chief's table, within reach of his hand and so arranged that he could easily use any one of the maps by pulling it towards him. A central telephone station in the same office could put him in communication with the artillery commanders in the different sectors almost instantly. Thanks to maps and telephones there can be an intelligent co-operation between the commanders and the various artillery services.

Maps on a scale of 1:100000 were used to mark the positions of friendly as well as hostile batteries. Aviators are charged with the duty of locating hostile guns and emplacements. This is done by aerial photography. As soon as the aviators land they send their cameras with films to the photographic laboratory where they are developed and carefully compared with maps and other photographs to note any change in the terrain. The photographs are oriented on the maps and any change which would indicate a gun or emplacement is easily transferred to the map.

Once the artillery positions are definitely fixed, the Staff, with the assistance of sector artillery commanders, makes a complete study of all contingencies that might arise either in an attack or in case the enemy took the offensive. With the object of avoiding confusion all the instructions, orders, etc., resulting from the above mentioned study and its consequent decisions are printed on slips of transparent paper which are laid one above the other and located at the point on the map which has been chosen as the battery emplacement and might be called a base. This study also brings out possible concentrations of fire in case of an attack by the enemy or in case of a local offensive. As additional information, the names or title numbers of batteries which could assist in a particular kind of fire are marked, and their positions located. This previous study is given great importance and is a continuous duty at the Corps Headquarters, which is really the directing point for artillery control. It is attempted to fore ce and prepare for every contingency in the positions and grouping of batteries.

Along the same lines great importance is given to the work of certain artillery observers in the front trench lines, as well as those in rear with the batteries themselves. These observers try to find out which enemy batteries are located for counter-battery work and further exactly which German gun is the target for a particular allied gun. Also, these observers register the number of rounds fired by each Allied gun, the hour of each shot, and the total number of rounds fired per day. All this last information is marked along an arrow drawn on the map from the position of the Allied gun and in the direction it is firing. This collection of information is a tremendous task.

In this same office there are maps which show positions of completed battery and gun emplacements which have not yet been occupied by the artillery.

These works and emplacements are divided into two groups; i.e., those which are built solely for a change

of position, necessary when a battery has been consistently bombarded and its original position destroyed; those which are built in rear and are to be occupied in case of a forced withdrawal. In either case positions are prepared so that a gun can open fire as soon as it is emplaced. With this end in view all positions are constructed on the same plan, with the same quantity of ammunition in each magazine. The telephone lines are always laid and ready to be connected up. The bombproofs for the gun crews are always in good shape. The construction of several emplacements for each gun has a secondary object of deceiving the enemy as to the number of guns engaged at any one time, and their respective positions.

On account of the great activity of the aero-observers the Allies make use of dummy batteries, made of wood and located in the vicinity of the real battery. The positions of these dummy batteries are also registered on the maps.

To tabulate and keep up to date the great mass of information collected at the office of the Corps Artillery Commander necessitates much work; but the information is so extensive and complete that it simplifies and abbreviates the solution of almost any problem that may present itself.

Ammunition Supply Service of the Supply Inspection Department

In the Fourth Army the Supply Inspection Department receives ammunition daily from Germany over the railroads. Trains arrive daily into the Fourth Army zone and distribute the ammunition between different points where it is needed, or where the High Command may designate.

In the early stages of the campaign the munitions did not leave the railroad cars; it was divided into two classifications one of which was turned over to the Supply Inspection Department which could distribute the ammunition according to the necessity of the moment; the second class was left to the disposition of the High Command. It soon became evident that this system kept too many cars idle and storehouses had to be constructed for the ammunition. Another reason for the construction of storehouses was the activity of the enemy airmen who were continuously blowing up ammunition trains.

These storehouses are constructed in the form of platforms on piles which are high enough to prevent dampness from rising into the storehouse and at the same time facilitate loading and unloading from railroad cars. In cases where two tracks of different gauges run along each side of the storehouse, the narrow gauge road is built up above the level of the broad gauge road so that the cars on both tracks will be at the level of the storehouse floor. The narrow gauge roads deliver the munitions from the storehouses to the army corps supply points, from where they are carried to the division supply points. From the division supply points the ammunition is taken to the batteries by almost every sort of conveyance. The usual method is over a Decauville line in small cars hauled by a gasoline engine. These small cars are sometimes run over wooden rails reinforced with angle iron.

We saw two ammunition columns, one auto column and one horse drawn column. The former consisted of seventeen 4-ton trucks, one work truck, and one automobile for the commanding officer. The horse drawn column consisted of 24 wagons each drawn by 3 teams. In addition there were two repair and one kitchen wagon. Four men armed with carbines ride on each wagon.

Special wood and metal cases are used for the transportation of projectiles. The construction varies for the larger calibered projectiles and the powder charges are carried in similar cases.

The smaller calibered shell and cartridge cases are also carried in wooden cases provided with metal partitions and braces.

A careful study is made of each new type of enemy shell and powder charge captured, immediately it is in German hands. This study is followed up by a rapid construction of similar shells and powder charges, which are then transported to the vicinity of the place where the original Allied model or models were taken. It is by taking this measure that the Germans are able to make use of the Allied cannon that they capture.

[Deductions from the World War. By Maj.-Gen. Baron von Freitag-Loringhoven.]

(The first part of this important exposition of the German idea as to what lessons should be drawn from the war appeared in the February and March issues of the INTERNATIONAL MILITARY DIGEST, having been condensed from *La Guerra y su Preparación* before any other notice of the work appeared in English. The concluding installment of the article was not received. In order to make the digest complete, the remaining portion of the work has been condensed from the English translation by J. E. M., which recently appeared in book form.)

While the world war has not entirely revolutionized warfare, still it is incumbent upon us to draw from the war its lessons in developing and training our army.

Organization will have to be made as elastic as possible, since no set organization can cover every contingency that arises. It has been impossible to maintain our old organizations during the war and thus preserve the influence of officers over their own men. The divisions have become the strategic units and have been developed as such. Army corps have become army groups. The number of divisions has not remained three, but has varied according to the mission, the commander and the situation.

The war has shown that infantry must be equipped with a larger number of machine guns than we had in time of peace. In defensive war the tendency has been to substitute machines for men thus saving the man power. The artillery was increased in the number of howitzer batteries. There has been a necessarily large increase in the garrison artillery, engineers, bomb throwing companies, railway telegraph, motor troops and air forces. The cavalry will have to be kept at its present strength. The reserve cavalry will be cut down so that men and horses can be used elsewhere.

EUROPEAN WAR—Continued

Cavalry is not very useful against massed armies, where it has been replaced by the airplane. Neither is it effective against modern weapons. However, it has proved invaluable in certain cases early in the war, in Lithuania, in Rumania. In open warfare it is an important arm for reconnaissance, mobile defense, and as a swiftly moving force which can be rapidly thrown from one point to another. More attention will have to be given to trench warfare and fighting on foot by the cavalry.

The great maneuvers of the future will only partially represent the conditions of this world war. Trench systems cannot generally be constructed, all that can be done is to practise attacks on field positions oftener than heretofore. All men will be trained in the essentials of trench warfare. Troops on frontiers will combine this training with the construction of field fortifications. Correct views must be preserved in respect to trench warfare—but it must not be predominant in training—the predominant place belongs to the war of maneuver. In this connection maneuvers of the future will have to be dragged out so as to more nearly resemble battle conditions.

As early as 1866 Moltke and King William both realized that an infantry assault to be really a success had to be prepared with artillery and accurate rifle fire. At the opening of this war our infantry was perhaps too headlong and the maximum benefits were not reaped for that reason. But this untimely boldness is a valuable asset to any army. We must maintain by every means this splendid vigor in attack of our infantry. The infantry must not expect too much from the artillery. Co-operation between the infantry and artillery must be insured in any event. A good way to insure this would be to effect mutual exchanges between officers of infantry and artillery in time of peace.

More attention must be devoted to tactics on a large scale, and less to strategy. In maneuvers it should be the object to develop the power of forming just conceptions of tactical situations, and to practice the technique of command. Operations on a large scale must be left to the General Staff, especially the Great Genenal Staff. The greatest simplicity in drills and exercises should prevail on the drill ground. The lessons of the great war can be made to strike home when given in the form of lectures.

Our traditional drill must remain the permanent imperishable foundation of our training.

The importance of this drill lies in the fact that it teaches the soldier the urgent necessity of obeying his officers.

We must thank our training schools for the iron discipline which has made no task too great for our soldiers to undertake, and which has made it possible successfully to maneuver great masses of men before the enemy.

Our allies are reluctant to recognize the discipline of our soldiers, tho General Cherfils in speaking of the autumn, 1915, battle of Champagne does give us credit for having the true soldier discipline whereby a soldier does not detach himself from his officers. Similarly *La France Militaire* in speaking of the July, 1916, battle of the Somme says, "The great homogeniety of the German Army enabled them to withdraw some 20 different battalions from 10 different divisions and oppose our organized advance with these battalions." A militia army with a short perod of training may accomplish deeds of heroism but it will lose all its strength if compelled to break up its units. The French have tried to organize the many new reserve units in such a way as to give them the solidarity of the old troops. Tho inspired by the highest ideals of patriotism the young reserve officers and war volunteers lacked the all powerful soldierly discipline and physical hardihood which can be acquired only in the course of a thoro military training. These troops were unable to cope with the difficulties that prevailed at Ypres. Gradually, and as a result of the war practice, these volunteers are becoming the equal of the old troops.

The Prussian Landwehr of 1813 was not sufficiently trained, and it was the old Prussian Army, filled with a new spirit, that was responsible for the liberation of 1813. It was the "Junkers" of 1806 who led to victory an army composed mostly of veterans. The great achievements of 1813 as well as those of 1914 were due to the excellence of our "Cadres," and the only reason we have been able to hold out in the world war is because we had a sufficient number of experienced officers and veteran soldiers to begin with.

Scharnhorst's "Krümper" system which consisted in maintaining a war reserve by constantly furloughing a number of men from each regiment back to their homes, and inserting new men in their places, was not a success. It could not furnish the required number of men in the short period between 1808 and 1813 to fill up the auxiliary corps. The greatest part of the reserve force available in the provinces in 1813 received its training in the old army, and had been subjected to its rigid discipline.

If the battle of Katzback had been fought with thoroly trained men it is possible that MacDonald would not have been defeated. There is no greater example of fortitude of mind and body in the face of reverses, hunger and thirst, and inclement weather. This stoicism is the gradual result of military training and is simply a heightened sense of duty and honor.

If the Amercan Union forces had been composed of well trained soldiers the civil war would not have lasted so long—as it was it took three years of war to train the forces.

Lord Kitchener accomplished a great achievement when he built up 12 divisions out of 6 divisions of regulars and 28 divisions out of 14 territorial divisions. To this were added 30 so-called Kitchener Divisions which underwent a long period of training in England and later behind the lines in France, so that the English Army as a whole, was not in fighting shape until early in 1917. This army was trained especially for trench warfare and the British officers themselves admit that they are in no way prepared for maneuver warfare. The officers of higher rank require the knowledge which can only be gained after long training and by regarding it as a life work.

With regard to the abridgement and simplification of our infantry drill regulations, the war has proved that formal military drills are entirely beneficial, as long

as they are not carried to excess. These drills engender in troops the habit of doing their best and hence of doing their best in the face of the enemy. As for musketry training, the object should be to make each man a conscientious, technically trained rifleman.

In determining the importance of formal drill it must be kept in mind that drill is not an end, but a means to an end. The prospect of war must be kept strictly in view. The higher commanders will determine the courses in formal drills and will see to it that the purely "mechanical heads" do not triumph.

We must not carry our cult of tradition too far. While a great tradition is a wonderful "invigorator" for an army it must not kill the craving for continuous development. It must not be followed for its own sake but for the stability it gives an army.

From the beginning of the 19th century and up until the time that universal service was introduced, the tendency was towards review tactics both in our army and in the Russian Army. The end of all training seemed to be the holding of perfect ceremonies. The officers became pedantic, and the orders and regulations aimed at excessive preciseness and hair-splitting —which is not only useless but harmful.

With the advent of universal service, the officer became an educator in more ways than ever before. And under the leadership of the Prince of Prussia the parades and other ceremonies were put in their proper places—not as an end in themselves, but simply as a means of insuring order among troops. As the Prince of Prussia wrote in 1840: "If the spirit of order exists in a troop it is possible to do anything with it, without order nothing can be done."

The German Army has always preserved its handsome outward appearance—not from prejudice of what was old and traditional but because our chiefs have realized that a handsome army fought well—a neat appearance is always a sign of good discipline and insistence upon neatness is a manner of instilling discipline.

The warlike spirit is the factor that wins and not the tactical form, which must be elastic and applicable to any situation.

With reference to the relations between commanding officers and their men they must be founded on subordination and respect. The general must be loved and respected and not looked upon as a scolding taskmaster. His presence must inspire troops to the highest deeds and the greatest sacrifices. This idealization will only occur where the officers have made the proper impression on their men in time of peace.

There has been a great deal of talk in Germany lately about the so-called trench-spirit and of the fine relations existing between officers and men. . . . These relations are based upon a solicitude for the soldier's comfort, and existed before the war. The officer makes a difference in his treatment of the old soldiers who are the backbone of the fighting force and the new men who are not entirely trained. In general a greater equality will prevail amongst men who are facing death together. The lack of officers after August, 1914, made itself seriously felt and our men often faltered in the attack thru sudden loss of their leaders. Good relations must always prevail between officers and men, but these relations must not be prejudicial to the officers' authority.

Our young men who have outgrown paternal influence during the war stand in special need of this rigorous training and subordination offered by the army.

During the time of Schwerin he wrote that fear and love were the two instruments by which soldiers were governed, and fear did the lion's share. At present the case has, of course, been reversed. The officer nowadays governs by his personality, by his knowledge and by his enthusiasm in the work at hand. The world war has shown that discipline must be preserved and that the best types of men must be enlisted for the services of officers.

In comparing the reserves from the rural districts with those from the towns and industrial centers, it is unjust to depreciate the latter. The former are better physically, while the latter are more apt in the modern technicalities of warfare and new weapons because of a quicker intelligence. The prejudices in the Officers' Corps which existed on this subject before the war have since perished.

Our present army is a national one in which the human personality of troops must be recognized—social conditions demand this—and in which the officer's task is a social one—that is in an aristocratic sense. Our efficiency has been due to the fact that our Officers' Corps is a thoroly aristocratic organization on a democratic basis.

By proper selection of officers, the structure of the Officers' Corps can be made a counterpart of the structure of the nation, where the leaders are those who rank highest in intellect and education. The world war has shown that devotion and contempt of death are the natural heritage of every German soldier. But it has also been a mutual song of praise and confidence such as the world never has seen.

The spirit of German militarism, as Prussia first developed it and as Germany adopted it, is every bit as monarchical as it is aristocratic and democratic, and it would cease to be German and the mighty expression of German imperial military power and military efficiency if it were to change. If our enemies, to whom with God's help, our militarism will bring defeat, abuse it, we know that we must preserve it, for to us it means victory and the future of Germany.

The war has brought about an almost complete fusion of officers of the active army with those on the reserve list. We carefully prepared the officers of the reserve and of the Landwehr for the tasks they would have in war. Their training is carried on thru the war—especially in the case of the young captains, by means of courses of instruction behind the front. Great results have been obtained by this means but the real reason for the ability of reserve officers is found in the connection with and guidance given by officers of the active army. The long duration of the war made these reserve officers entirely forget their civilian professions. They have become professional soldiers with that added intelligence and energy which characterizes the German whenever he occupies a responsible business position. At present there is no visible difference between reserve and active officers.

EUROPEAN WAR—Continued

Our regiments were commanded by Staff officers who were younger both in years and in military experience, than was customary before the war in these positions. This will not be the case in time of peace. In peace time Staff and field officers are needed who have fully matured and self-assured personalities, whereas in war it is just the officers holding the middle status of regimental and battalion commanders who are subjected to the severest strains. This should warn us not to allow our field and Staff officers in peace time to hold their positions after a certain age.

It proved advantageous to promote worthy non-commissioned officers to the grade of officers both on the reserve and active lists and to extend the sources from which officers were selected. Many prejudices were set aside to do this, but the results were beneficial.

In peace time many claims are made upon the officers who disappear so rapidly in war and no matter how important it is to prepare for war, the choice of officers will be limited—as education, intellectual bias, and ambition are not enough to fit a man for the position of an officer.

The spirit of German militarism which has enabled us to stand the test of the world war and which we must preserve in the future, because with it our world position stands or falls—rests ultimately upon building up a strong officers corps which will be thoroly efficient for purposes of war. For this purpose a sound aristocratic tradition is necessary. This is in no way connected with so-called junkerdom and caste feeling. Aristocratic tradition is of great service in training personalities—and an officer must have a personality. The choice of the most suitable men can only be accomplished by a gradual replenishment and not by an arbitrary placing of everybody on the same level.

The warlike efficiency of the ruling class in Japan is a result of the traditions which lived in the old Samurai families. The success of Napoleon's army was due in a large measure to his selection of officers from the old nobility and the building up of a strong military hierarchy.

In any case the masses, as such, can never rule—and mob-rule in an army is more of an absurdity than in the case of a state. Russia's present so-called army is useless for war purposes.

Only under the absolute command of a war lord can an army achieve a really vigorous development.

It cannot be emphasized too often what an immense debt the Prussian Army—and hence the whole German people—owes to the Prussian kings.

The *Spectateur Militaire* of the early sixties, says: "The French soldier sees in all his officers from the sub-lieutenant to the field marshal, merely his equals; he is certain that he is inferior to them only in military rank. These soldiers who stand on the same level with their officers but whose 'ego' is completely dominated by discipline cannot be resisted by any human force."

This is an instance of the French notion of the supreme blessing of equality, which really signifies nothing and is far from being equivalent to freedom as the world war plainly shows. France is not a liberal state but a plutocracy. Moreover, every nation is fortunate in having its own idea of discipline—we are satisfied with our particular kind and we intend to hold fast to it. Since the reforms of Scharnhorst it has been a principle with us that the officer is raised above the men both by education and training. And as the standards of education of the masses have been raised during the last 100 years so have the standards for officers been raised. This education does not consist in piling up a mass of learning. School education of youth gives a foundation on which a knowledge of life is later built. The various methods of teaching make no difference—so long as the school furnishes the proper basis upon which to build a further knowledge, it is fulfilling its object. Experience has taught that a man does not begin to learn until he has left school—only then does he begin to see things in their true relations. The war which has reduced many things to their true value has taught us the difference between acquisition of learning and education. All of us who have talked with our soldiers have rejoiced in their sound judgment. Their simple understanding often has a higher degree of freshness and impartiality than can be found in the so-called educated classes.

The old system of classical education kindled in pupils the desire for a humane and liberal culture, by avoiding a smattering of everything, and dwelling firmly and consistently on one or two subjects.

Since 1882 the Prussian system of state examinations has been improved so that they have justified themselves, and they are really a necessity in a big state.

We shall do well in the army if we endeavor to have all ensigns and cadets pass their final examinations before entering the service.

These things may appear to have very little to do with the great war—and as a matter of fact considerations resulting from the war cannot be made the basis for an educational system—but at the same time the developments and changes which will result from the war make it necessary to subject our national life to a very strict examination in all its departments. Moreover the training of youth is connected with the development of an armed force. The training of the young business man of the future must be such as to qualify him for the training and handling of men, and to give him a self assurance in dealing with any subject. In the training of an officer the most important thing is the cultivation of a distingushed mode of thought and the training of character.

The officer must possess a thoro appreciation of technical science but this must not lead him to forget his study of men. Knowledge of men is the fundamental condition of successful leadership. Hence the study of military history, which gives this knowledge, is of the highest value.

The fact that so many younger staff officers, and in fact all the Staff officers, have proved themselves capable of filling positions of greater responsibility than compatible with their age and experience, goes to prove that our Staff training is correct and that our Staff college is working along the proper lines as set down

by Field Marshal. Count Schlieffen. Schlieffen's successor, Count Gen. von Moltke, rendered great service by increasing our armed force and by training Staff officers with a view to war.

Regular officers, half-pay officers and reserve officers have all held their own—they have done well in the field, on the lines of communication, in occupied territory, and at home. And this is due to the fact that military efficiency is nothing less than the exercise of sound human intelligence.

These facts prove that we are working along the right line, but we are still far from perfection. After the war there will have to be a great remodeling on the basis of new experiences. We must not forget that this has been a long and stationary war with plenty of time for men to train and study while taking part. On the other hand we have learned the variety af tasks which an officer may have to do and for which he has to be prepared in time of peace. A deepening as well as an extending of professional knowledge is to be aimed at.

The training at the Staff College will never be possible for more than a limited number. The war schools will never be able to give a complete course even tho enlarged and their courses lengthened. There is always a great need for after training which before the war was always left to the individual—and not every one is capable of attaining it unaided.

Therefore it seems desirable that an intermediate stage between war school and staff college be established where 9 months courses can be given to the senior lieutenants.

By sending officers who have already gone thru the war schools to the intermediate schools, we could increase the number of candidates for the Staff College by one-third the present attendance. The Staff College will continue to be the nursery for the General Staff, the higher adjutancy and the military teaching staff.

In order to get the proper results the above mentioned 9 month courses should be established at university towns where the services of professors could be turned to account. This world economic war has revealed the necessity that officers should be familiar with political, constitutional, economic, and social questions so that they can form their independent judgments on these subjects. Still the officer must not be a politician.

The untiring application which King Frederick demanded of his officers must be insisted on more than ever after this war. We do not want officers with scholastic training but officers with well trained minds.

Still Ready for War

The war readiness of Germany had been greatly increased by the votings of the last army bills and by the naval construction. Yet we have had to organize great new formations and further develop armaments beyond anything anticipated. The tax of 1,000,000,000 marks measured on the scale of war costs no longer seems an immense sacrifice. The war has revealed our full financial strength and also has proved that additional expenditure on the army at the right time would have been profitable. We should then have saved many lives as well as milliards of marks. In view of our central position, larger expenditures on the land army and the fleet were absolutely necessary. The demands put before the Reichstag in this connection were feeble reminders of what was actually needed.

In future we must disregard every objection and we must see that the disproportion between the credits asked for, and what has been done in war, shall never be as great as in this present struggle. The recent enactments which call to the colors men fit for service whom it had been impossible to enlist before, tends to make our compulsory service truly universal, as it must continue to be. We will also require quite an increase of garrison artillery and technical troops.

In the case of those men who have enlisted at the age fixed for military service, the length of their prescribed term of service cannot be shortened without detriment to the entire army organization. Furloughs might be granted during the second and third years of service. The object of our associations for young men, will be to qualify the greatest number of men possible for service in the army.

It may be asked—what is the necessity for all this? will not the general exhaustion of Europe put the danger of a new war into the background? will not the terrible slaughter bring disarmament and permanent peace? The reply is that no one can undertake to guarantee a long period of peace and a lasting peace is guaranteed only by strong armaments. Our own armament, tho it may have been defective, secured peace for us for 40 years—a longer period of peace than any other great nation has ever had. World power brings with it the expression of power in the world and hence demands sea power; this in turn brings causes of friction between nations—which in turn demands armaments on land and sea.

A sound policy of power is not a glorification of war, tho war is very beneficial in that it banishes pretense and reveals the truth and produces the most sublime manifestations of masculine personality and devotion for the community. However convinced we may be that war is a sin against humanity, that it is something to be detested, this brings us no nearer to eternal peace. War has its basis in human nature and as long as human nature continues to remain unaltered war will continue to exist.

As states develop, international courts of arbitration will eliminate many causes of dispute between states and agreements will be made between them, but these agreements are only treaties, and will not be able to hold in check the forces seething within a state. The idea of a universal league for the preservation of peace would be felt as an intolerable tutelage by any proud spirited nation.

America's behavior in the war has shown that pacifism as represented by America is business pacifism and hence crass materialism. The appeal to democratic tendencies does not alter the fact for it is the democracies who have risked the future of their own people.

At any rate, as far as we Germans go, this war should disencumber us once and for all of any vague cosmopolitan sentimentalities. We will listen to no new prophets but to old and truly wise men, and seek

EUROPEAN WAR—Continued

cohesion in our glorious army and our belaurelled young fleet.

[The Teachings of the World War. From the translation in *Kungl. Krigsvetenskaps-Akademiens Tidskrift*, Dec, '17. From *"Folgerungen aus Dem Weltkriege,"* by The Prussian General Lieutenant v. Freytag-Loringhoven. 5000 words.]

The author does not mean to solve all the points of view which have arisen in the world war. He treats his subject under the headings: "The Political and World Economical Situation of the Central Powers," "The Inner Spirit of the War of Peoples and Masses (die Psyche)," "The Influence of Technique, Leadership," "The Army in the Future," and "Always Prepared for War."

The author finds it urgent, in view of the experiences gained in the war, to put the life of the whole German people and the organization of the German Army before the court of consideration.

The Political and World Economic Situation of the Central Powers

What the author says on the subject does not offer very much novelty for those who have followed the start and developments of the world war and the political combinations regarding it with some attention. The war put Germany in a very difficult position, cut off as it was from the import of raw materials and foodstuffs, while America as the hidden ally of the Entente rendered the Allies the most valuable services thru supplying all kinds of war material and money. However the Central Powers were able to develop and put thru the economical activity necessary for the war, and the situation was improved by and by thru the conquest of Serbia and Rumania, but on the other hand the enemies of the Central Powers had succeeded in finding new possibilities of resistance by reason of having freedom on the seas. That is why victories which should have been decisive did not lead to the desired result, and that not even the conquest of kingdoms brought the peace nearer.

The world war is an irrefutable proof that Germany must hold on for all future *"den Anspruch der Seegel tung."* Its problem, originating in the geographical position of the country, would be to bring into harmony the exigencies of the world economy and the economical questions of the people in its more narrow aspect as well as the continental and colonial policies.

Against the common supposition, the world had been able to stand a long war, but with a destruction of values which humanity had not hitherto experienced. Billions would have been saved if, according to the ideas of operation of Schlieffen, the Germans had succeeded in a decisive attack against the front and both flanks of the enemy in France. This did not happen at the Marne, however. A complete victory there would have given another outlook. It certainly would have shortened the war considerably. The full importance of *"der Entscheidende Waffenerfolg"* is emphasized in the present war which is so dependent on all kinds of world economic factors. Only the open warfare has brought positive success to the Central Powers.

The Inner Spirit of the War of the People and the Mass War

Under this heading, the author preoccupies himself mainly with the French, English and Russian armies, besides the Germany army and soldier.

The German folk army, founded during the wars of liberty against Napoleon, met in August, 1914, the organized conscription of France in which the hate of a war of revenge was glowing. Thru the first German victories the self-consciousness of the Frenchmen was tottering, but it returned after the battle of the Marne. Then their zeal was influenced by all possible means and the French soldier has been infused with the idea that the issue is not only liberating their country from a hated invader, but a fight for the future position of France in the present state system. Hence the attacks of the Frenchmen with whole divisions in dense masses.

England has created an army during the war, and the war zeal has there only lately seized the masses. In spite of an extraordinary training, the new English divisions have not reached the battle value of the French organizations. The battle technique of the English has been developed to a high degree, but not so their tactics. Changing from an enlisted army to a conscripted army, the English Army began to interest itself more for the war aims of England and at the same time hatred against Germany was raised. By nature less irritable, the Englishman sticks to the opinions which he has once adopted. In this way Germany has ended by fighting enemies which are under the influence of a *"Massenpsychose."* Phenomena have seen the light which Europe has not known since the religious wars; for example atrocities and meaningless rage of destruction. It has also tended to show what a great difference there is between civilization and culture.

Those who have hitherto judged the French people by the adopted standard have been surprised by their morale in the war. Even the behavior of the Russians has brought surprises, but to a smaller degree.

The moral element has again and again proved itself to be a deciding factor in the war in spite of the perfection of all technical means. In this connection the author cites the words of Droysenu that the material means and the masses are not enough, but that there are other considerations, mainly the ethical, which guaranteed and won victories, viz.: the careful education of the people of all classes; order and subordination which give the masses form; the discipline which makes them useful even in failure; the competition between all noble feelings which steeled the souls; the strong will which led the whole; and that power of thinking which led to the desired goal.

The Influence of Technique

The author emphasizes the great importance of technique on the effect of arms, on protection, on communications and information, and on the air war. During peace these things had been more guessed at than realized, and first the war fully illustrated them.

The importance which the railways have in war is brought out by comparison between the railway transportation in the years 1870 and 1914. In the year 1870, at the mobilization, these transportations did not even number half a million on the German side, but in the year 1914 in round numbers one and a half million. The development of electrical communication for military purposes appears from the fact that now orders and reports are transmitted right into the battle, while for example the day before the battle at Königgrätz no telegraphic connection existed between the Prussian High Command and the army headquarters of the Crown Prince of Prussia. Such rides as were performed by Lieutenant Colonel Fickenstein the night before the mentioned battle (between the 2nd and 3rd July, 1866) are replaced by travel in motor cars. The war is now as before a thing of uncertainty in spite of all the means of communication and information.

The airplanes and airships were an untested war factor in the beginning of the war. A new arm has been developed of them. The airplanes have won the ascendancy over the dirigibles and proved themselves to be an active means of scout service as well in operative as in tactical respect. They have rendered the most excellent services in immediate connection with the infantry as well as in observation for the artillery. As cavalry battles have taken place up to now in front of the other troops in order to put the cavalry of the enemy out of action, so air fights are now fought with the same purpose above the fronts. Furthermore we have bomb throwing from airplanes.

The new means of fighting in position warfare as well as the greater importance of the artillery fire are mentioned briefly in order to pass over to the question whether the fortified trench lines ought to replace fortifications (forts).

In this connection the quotation of Napoleon I is mentioned: forts as well as guns are only arms which in themselves cannot fill their purpose, but must be employed in a useful way; for the building of forts the same principles rule as for grouping of troops. The forts should thus support the operations, but as the course of these could never be predicted with certainty, it seems that they ought to be built during the war itself just where they would be most needed. This would, however, go too far. It is impossible to omit certain prepared strong points of support, where the army is limited to the defense. The value of such points of support the forts on the eastern frontier of France, above all Verdun, and the fortified Moselle front, have shown. The German heavy artillery had not been effective enough at Verdun to make the fortifications ripe for storming, which proves that cleverly constructed sunken forts in specially well chosen places now, as before, may have a great value.

It seems obsolete to fortify big towns. Towns have lost their importance as the kernel of the fort, and will in the future only serve as points of supply and as garrisons within fortified zones. Such zones may be necessary to secure certain frontier districts and ought to be formed by fortifications constructed during peace. They ought to be continuously modernized, and should be extended in the beginning of a war. Necessary material ought to be stored for this purpose during the time of peace. The idea would not be to create a continuous fortified frontier (*"einen durchlaufemden 'Limes'"*). Such a frontier would only be suitable for defense in position warfare, such as tne one which the Germans have been compelled to adopt in the world war on account of circumstances. Instead a certain number of strong points of support for the defense ought to be constructed, not in form of fortified towns, but in form of fortified important zones. The world war has proved the old truth that the attack only has decisive importance and that the open warfare, not position warfare, is to be striven for. On the other hand, it has emphasized the immense strength of a defense supported by well constructed fortifications, a fact which is of especially great value in view of the geographical position of Germany.

Leadership

After the Boer war and the battles in Manchuria during the Russian-Japanese war, it was necessary to warn against one-sidedness, and even now such a warning does not seem out of place. The long position warfare introduces the danger of one-sided methods. Those who will not take the experiences of previous wars into consideration take too narrow a view. In warfare it is always necessary to find the right proportion between knowledge and execution. Clausewitz said strikingly, that he who wants to move in such an element as war ought to carry with him only one book, "the education of his mind." If he would take with him ideas already made, ideas which the impulse of the moment had not been giving him, ideas which had not sprung out of his own flesh and blood, the current of events would carry away his building before it even was finished.

The teachings of the past must be developed and made to suit the present. Thus Moltke, Sr., had done, with such an aim Schlieffen had worked, and the younger Moltke had adhered to his principles.

The campaign in the west was opened up in the spirit of Schlieffen in August, 1914. It aimed at a double flanking of the enemy. The left wing of the German Army was, however, detained by the forts on the eastern frontier of France. The right wing, which was successful in the beginning, was now flanked, since Joffre in his retreat had grouped the French main forces between Verdun and Paris and brought together an attacking army on the German right flank. The German offensive was not strong enough to penetrate into a hostile country which was bristling with arms. At the time of the battle of Marne the French, English, and Belgians had a superiority of numbers which might be estimated in round numbers at three-quarters of a million men. Still another army would have been necessary to place behind and overlap the German right wing to secure success. Little was, however, lacking to win a victory which would have made the strategic retreat to a new front superfluous.

The situation after the battle on the Marne was in

EUROPEAN WAR—Continued

fact such that a flanking of the whole German west army might have been possible. The French were in the position to throw strong forces at the right moment against the right flank of the German Army (using their favorably situated and well organized railways, and their numerous motor cars), thereby preventing the Germans from gaining a footing at the Aisne and at the Belgian frontier. As the French, however, had not gained any tactical success at the Marne, the strength and the ability to proceed were lacking. Only frontal pressure was employed. When the Germans were again partly on the offensive, they tied and held the forces against them in check.

After the retreat to the new strategic front, the war on the German side had the character of an attacking offensive ("of an offensive with limited aim," to quote Clausewitz), which in the end of November, 1914, changed to pure position warfare. It might have been a question, on account of the overwhelming artillery and mine-thrower fire of the enemy, of letting him break thru at a certain part of the front in order to throw him back behind the fortified lines by means of the reserves. Such a mode of procedure on a big scale did not seem advisable, however, on account of the limited forces and artillery at our disposal. The pronounced exertions of the enemy to break away for their infantry by mechanical force (the heaviest artillery and mine-thrower fire) led to another mode of procedure. This was characterized on the bulletin of the German High Command of 17th of April, 1917, thus: "On account of the present fire which levels the positions to the ground, and creates broad and deep shell craters, the straight defense (*die starre Verteidigung*) is no longer possible. The battle is no longer about a line, but about a deep fortified zone. Thus the battle is moving to and fro about the first positions, even if thereby war material is lost, in order to spare lives and to weaken the enemy decisively thru heavy casualties." The basis of this new method would, however, be an immediate disposal of sufficient reserves for counter attacks and necessary munitions.

As has already been pointed out, it did not seem advisable to expose great parts of the front in order to meet the enemy on French or Belgian territory in a big offensive battle. Such an attack would have had to conquer newly created enemy positions. In case of failure, still more of the occupied territory would have had to be evacuated. Besides, the issue for the Germans was to utilize the fertile and industrially rich northern French territory on the most extensive scale.

The moving back of certain parts of the German front at the Ancre, Somme and Oise at the end of the winter, 1917, was not done until more favorable and stronger positions were arranged further back. In this way heavy casualties were inflicted on the enemy, time and strength were saved.

In connection with these statements, the author mentions the difficulty of inflicting on the whole hostile army a "Cannae." Separate armies might be completely surrounded, as, for example, at Tannenberg and Herrmanstadt, but to surround the whole hostile forces would be a difficult problem. At the Marne another army would have been necessary, and in the east the effect of every flanking movement was very limited. The Russians could escape in time by means of their railways. On account of the immense front, striking at one of the Russian wings did not have any influence on the other one, at least not to any great extent. Circumstances forced battles of penetration, such as at Gorlice-Tarnow and on the Narew front (1915), and at Tarnopol (1917).

It would be wrong to state, the author says at the end of his reflections on "Leadership," that in the future position warfare must be as prominent as in the present war. Germany ought to strive for preserving the character of the open warfare, as she has gained decisive victories only by means of this kind of warfare. On account of certain factors the offensive operations will be slower in the future, but the open warfare is decisive and should remain so. "In this respect our opinion will not be altered by the years in the trenches." The spirit of attack must be taken care of. This does not, however, mean attack always and under all circumstances. To stand by the principle of attack in the beginning of the war, even when the situation was such that it would have been more favorable to utilize the strength which, thanks to the present armament, is embodied in the defensive, has cost great sacrifices. The war has, however, showed that the statement "the spade is the tomb of the offensive," so often made in time of peace, is fallacious. Catchwords are always dangerous, above all where the lives of our sons and brothers are concerned.

The Army of the Future

Regarding organization, the world war has taught us that there is none which is able to meet all the exigencies of the war, and that it specially in this respect would be necessary to make it *"möglichst flussig und anpassungsfahig"* (as smooth and adaptable to circumstances as possible). The striving for retaining the original war organization had not been realized during the war, in any case it had to be limited to the divisions. The divisions became units of operation, the army corps, and often the army groups, changeable as regards composition and number of divisions. The question concerning the organization in three of the larger units had to yield to the exigencies of the war. The experience is not new. Napoleon never found it in any way objectionable to have different numbers of divisions in his army corps.

The infantry ought to be provided with an increased number of machine guns. Especially in the defensive it would be convenient to save human lives thru the employment of machinery—machine guns and mine throwers—supported by artillery. The field artillery in itself would not need so much an increase of the number of batteries as an increase of the batteries of mortars. A considerable increase of the foot artillery, the pioneers, the mine-thrower companies, the railway, telegraph and automoble troops, and the air forces would be absolutely necessary, however.

The cavalry ought not to be increased in the future, perhaps, but be kept at its present number, in which case it might be possible to limit the numbers of reserve

cavalry. The lengthy trench warfare and the circumstances that this costly arm has been used as infantry only during such warfare, ought not to lead to false conclusions. In open warfare the cavalry will again come into its own. The cavalry is indispensable to complete the aviation arm in close fighting and for scout service. It ought to be very mobile, ready to be sent out in different directions. During the training in time of peace it ought not to forget its shooting, and far more attention must be given to fighting on foot than hitherto.

As regards training, the methods of trench warfare can only be partly illustrated at the bigger maneuvers. The exercises, however, ought to be modified according to the present mode of warfare. As digging in on the training fields will only seldom be possible this ought to be done during the bigger maneuvers where possible considering the damage to the fields, on the assumption that it corresponded to the war situation. It is, however, not possible to illustrate trench warfare with large masses of troops during peace maneuvers.

More often than hitherto practice attacks against a fortified field position are to take place. The number and the extent of such exercises would always be comparatively limited on account of the expense. On account of this one could not go further than the training of companies and battalions in trench warfare. A correct idea of trench warfare is necessary, but such training ought not to predominate. We must always remember and inculcate that the course of battle will develop and go on more slowly than hitherto. Besides, more tactics than strategy ought to be practised, especially at war maneuvers and practice rides. The big operations belong to the general staff rides especially to those of the High Command. The officer corps in general ought to have a correct idea as regards large operations. This might conveniently be done thru the study of the world war and lectures on the same. In the practice problems on the training fields, the greatest possible simplicity would be necessary. War demands it.

The basic element in training ought to be the drill. Its importance is in the feeling that the men in command must be obeyed. The habit of obedience makes the road smooth for teaching this feeling. Regarding discontinuance and simplifying of the rules of infantry exercise, there might be different opinions. The exercise in drills as such hurts the training for fighting and delays the training for warfare when it is exaggerated, *i.e.*, when it goes beyond the rules for the formal exercises. This avoided, the exercise drill will have a good influence on the training for fighting. In the latter the same degree of subordination could not be reached in a short time and with the same simple means. But as sure as it is that much which the foot soldier has to learn for the fighting in extended order might be taught in the drill, just as surely the rules of the infantry exercise as the aim for the individual training of the soldier is this; "the soldier shall be educated to an individually thinking and conscientiously acting shot." There is no doubt that the training for fighting takes the first place, but that the rigid drill has a high value also.

In this respect the time which is given to formal exercises is a deciding factor. It ought not to be considered an end but a means to an end. It is, however, never quite possible to prevent some pedants, who could never keep the war in perspective, from getting into the wrong track. The problem of the inspectors is to keep such pedants from leading the training away from the main objects. Such inspectors must keep the mechanical brains from triumphing, as Scharnhorst says. Success in war will come to the one who understands how to liberate himself from the chains of habit at the right time. Even in the care and preservation of traditions one ought not to go too far.

The war has shown that the time of training cannot be shortened. The troops which were formed in the beginning of the war had not sufficient training to make efficient fighters. The young volunteers which formed the greater part of these troops were in themselves splendid material, filled with a great patriotic enthusiasm. This, however, could not make up for the deficiency in their training and the new troops were not equal to the severe kind of fighting at Ypres. Later in the war and after the reorganization of the officer corps, the troops in question became equal to the old army corps. The Prussian "Landsturm" offered a corresponding picture in the year 1813. Only later did they become effective soldiers. The divisions formed by Kitchener received a rather lengthy training in their own country before they were put into the fighting lines, and also behind the front in France. Not before the spring of 1916 were the English able to take over any great part of the front.

The last part of "The army of the future" the author dedicates to the German officer corps. The war has caused an almost complete amalgamation of the active and reserve officers. The care with which the reserve and *Landsturm* officers were trained from about ten years back has borne rich fruits. During the war there have been special courses behind the front, especially for training of company commanders. As regards recruiting officers, the limitations prevailing in peace have been done away with. During peace many requirements are exacted of an officer which do not exist in war times. However, not all who command regiments in war time would be suitable as chiefs of regiments in peace times. For such positions fully mature, enlightened personalities would be necessary, especially in view of the education of the officers and of the cultivation of homogenity of the troop. A selection is necessary when the aim is entrance into the active officer corps.

The professional education of the officer ought to be deeper and at the same time have a wider scope. It seemed convenient to introduce a course between the war school and the war academy (a nine months' course obligatory for all older lieutenants) as only a comparatively small number could be ordered to the war academy. This would be desirable also in view of the very short courses of the war school education during the war. It might be impossible to let all the officers who have received their commission during the war go thru the war school. Those who go thru the nine months' course with honors ought to be ordered to the war

EUROPEAN WAR—Continued

academy, which would then have to be two years only.

It is a duty to see without prejudice the human being in every soldier. The present social state of affairs and the accomplishments of the German folk army exact it. A folk army can only be a democratic institution. The problem of the officer is in a high degree of a social nature yet in a social-aristocratic sense. The German Army has accomplished so much because of the aristocratic institution of the officer corps on a democratic foundation. The present world and world economic war has shown the necessity for the officer to be so familiar with political, political economy, economical and social questions as to be able to form his own opinions on these subjects. The whole present national life points to it, but he must not become a politician.

The officer must have a full understanding of technique, but he ought to be a judge of people. The knowledge of human character is the basic condition for command. Hence the study of history, especially war history, is of the greatest importance. Such study is an inexhaustible source of education, an unequalled source of comfort during the boredom of the service in peace, thru keeping the mind alive to the great and elevated position of the soldier profession and helping to arrive at the right estimate of the moral element of war which might be lost during long peace.

The spiritual education thru serious study is a necessity not only for the officer of the General Staff, but for every officer who wants to fill a higher position within the army. What we need is "trained minds." The requirement is to transmute knowledge into practice. There is still much truth in Willisen's words: "From knowledge to practice there is a step, yet one from knowledge and not from ignorance."

Always Prepared for War

The war preparation of Germany will exact for the future at least a cursory training of those liable for military service who were rejected but later became serviceable, so that in case of war they might form a good source of reinforcement. For the conscripts who are of the service age and are enrolled in the army, the time of training could not be shortened, but furloughs might be given during the second and third years of training from time to time. A principal problem for the organizaztion of the youth is to work for the enrollment of a larger number of conscripts into the army. Besides strengthening the youth physically and morally, such organization ought to further athletics, knack (manipulative dexterity) and technical knowledge and thereby form an excellent preliminary school for the army. But they cannot be a substitute for the real soldier training. What is all this good for, however? The answer might be in short: there is nobody who can guarantee a long period of peace, but a strong armament would be a guarantee for a durable peace. A sound policy of strength is not at all the same as a one-sided glorification of war. One may abhor war as much as possible, but this abhorrence would not bring humanity nearer eternal peace. War has its foundation in human nature, and as long as human nature is not changed war will exist just as it has existed for thousands of years. "The wild beast exists just as well in the cultured man as in the barbarian," Treitschke correctly says. "Nothing is more true than the Biblical teachings of the deep sinfulness of humanity which could not be overcome even by the highest culture." Only a complete inner reformation of humanity could lead to the realization of true ideals of peace resting on real ground.

[The Causes of Trench Warfare and Its Future Possibilities. By Capt. of the General Staff Otto Ruge. *Norsk Militaert Tidsskrift*, June, '18. 6900 words.]

In 1914 the roads were, of course, far more developed than in the beginning of the 19th century; in spite of this, the present armies are no better off than those of the past. The singular march dispositions of the German armies in their invasion of France and the extensive road building activity of both sides prove this assertion.

The ability to provide supplies and the state of the means of communication of the theater of war did not offer any better facilities for a modern rapid offensive than did those of former times for the wars of Napoleon and Moltke. Also the third factor had changed to the detriment of the offensive.

Before the war all this had been thoroly studied. The operations in Belgium and France in the fall of 1914 were the great general rehearsal of open warfare with armies of millions. It was planned as a Cannae battle on a large scale. The invasion was stopped as soon as the Allies offered serious resistance. The German train could not keep pace with the armies, which suffered from want of supplies, especially the armies on the wings which had had the most extensive marching.

The battle of the Marne was conducted as a frontal battle by the German side, by that of the Allies as a flanking battle. During mutual attempts to outflank each other the front was gradually extended in a northerly direction. The German attacks did not bring a decision anywhere; the Allied troops were too tired to pursue when the Germans retreated, which they did without greater losses.

It is a question whether or not the Germans suffered a defeat at the Marne. That the battle did not lead to a real decision is sure. But the Germans had to give up their plans, give up territory, and go back; thus far the result of the battle was the same as that of the battles in Manchuria. This similarity is still more striking in the next period of the campaign, during which the front finally reached the sea.

The course of the battles was the same as at Liaoyang and Mukden; the frontal attack did not advance and the flanking movement was too slow; it was met by a corresponding extension of the front and did not bring about a catastrophe. The character of the warfare was the same on the other front, independent of the character of the scene of war.

The explanation is near at hand: armaments and tactics are the same everywhere; in the richer, more cultivated countries, the forces operating are so large that the scene of war does not, relatively, offer them

greater liberty of movement than the poorer countries offer the smaller forces.

There are exceptions to this general character of the war. In some instances the overwhelming numerical superiority of one side may bring about a more rapid course of the war (Serbia, 1915); there are also some successful breaches of fronts and some decisive flanking movements. These exceptions do not ,however, change the character of the war, any more than the brilliant tactical victories and sometimes successful offensive operations of Frederick II changed the type of campaign of the 18th century, or the guerilla wars in Spain, the fortified positions of Wellington at Torres Vedras, or the campaign in Russia, 1812, the opinions of the character of the war at about 1800.

All in all the warfare during 1914-17 could scarcely have been characterized better than Freytag-Loringhoven does in his reflections on the Civil War: "Circumstances create forms of warfare which in many ways resemble the warfare of the 18th century, even if the outer forms are different and have a larger aspect. On the deciding scene of war, Virginia, this war between peoples—as in the cabinet war of the 18th century—is moving back and forth for years on a comparatively limited territory." The conditions of the scene of war taken into consideration, he further says: "It is clear that some special points and lines of communication and the positions covering them would be of special importance, thus making trench warfare play an important part. If in the civilized countries nearly all positions can be flanked, the possession of points of decisive importance in a thinly populated country is a tremendous factor, especially in view of the lines of communication to the rear." Developments have proved the fallacy of his assertion; with the great armies of our times positions can hardly be flanked, even in the civilized countries.

Conclusions.—The lines of development of warfare traced in the previous article seem to be clear enough. It is, however, difficult to draw conclusions from this development as to the character of future wars. If we want to look into the future, we must limit ourselves, like Clausewitz, to investigating how the general material conditions will favor this or that mode of warfare when war breaks loose the next time.

VIII. Condition in Norway.—The author here points out the possible similarity between the present war and a war in his country. The most probable battle fields would be the wooded parts of the country, where the infantry would have to renounce its most powerful protection, the artillery. The moral means, the surprise and fear, would here be important factors. But the defenders who do not lose their morale have in modern arms a most powerful means of crushing an attack. The war has shown that even in the shortest distances the attack meets with the most effective resistance. The maneuvers in Hedemarken offered a situation similar to this, with an extension of the front on account of unsuccessful attempts of flanking.

When Charles the Twelfth invaded Norway in 1716, he reached Christiania after a series of flanking movements without, however, crushing his foe. He had to retreat to the frontier as soon as his lines of communication were threatened and partly interrupted These maneuvers of the general having the strongest predilection for the offensive of that time were a natural consequence of his not being able to, or his believing himself unable to, break the resistance of his adversary thru a tactical offensive. In a poor and vast country like Norway, with few and vulnerable communications, the threat of cutting the enemy off from his supplies and bases would always be an important factor.

Altho the circumstances do not necessarily lead to trench warfare, it is clear that the limited forces and, in consequence thereof limited battlefronts, will make it easier for the superior and more energetic side to gain a tactical decision than under the circumstances on the wide fronts in Europe at present.

IX. Possibilities of Technical Development.—Tanks will hardly become a permanent arm of the army of the future, at least not in Norway. The hand grenade will presumably be used in the future, altho it is not of such a value that it could change the character of battles. Besides, it is used in the offensive as well as the defensive.

The character of warfare is greatly influenced by the following arms:

Airplane.
Fortifications.
Machine guns and automatic firearms.
Artillery.

The full efficiency of the air service is hardly made clear yet, but it is presumably of the same value for the offensive as for the defensive. The same may be said of scout service. In general it may be stated that any scout service will be of more use to the offensive, because the one who is on the move has the initiative and the start, more easily utilizes information, and risks less by having his movements discovered. The effect of the air scout service may be compared to that of the cavalry.

Fortifications are mostly in the interests of the defense. Their importance is different according to the rapidity of their construction. Field fortifications are quickly constructed, and temporary ones which need more preparation. Comparatively seldom is there time to construct temporary fortified lines before the beginning of operations, such as those of the Danes at Dannevirke in 1864, and those of the Austrians at the Isonzo in 1915. Only later in the campaigns will such strong fortified lines be encountered, sometimes far into the country (Liaoyang), or when a fortified field position is improved by and by during the fighting and takes a temporary or permanent character (Richmond-Petersburg, 1864; Plevna, 1877; Tschataldscha, 1912; the Western Front, 1914).

If the aggressor is able to break the resistance he encounters in open battles or in hastily prepared field positions and thus is able to hasten the decision, fortifications will not be used to any great extent.

The need of machine guns and automatic fire arms seems to be unlimited. The only difficulties are how to procure them, the ammunition and the transport. Machine and automatic fire arms are just as necessary

EUROPEAN WAR—Continued

for the attack as for the defense, but on account of their nature they are more valuable for the latter. They are the basis for the tactical superiority of the defense. The tactical offensive will not be able to reconquer its superiority or even equality with the defense until the attack can dispose of means which allow a rapid destruction of obstacles and which just as rapidly can silence machine guns, even where they are protected by trenches.

The artillery has been developed rapidly during the war in two directions: on one hand an increasingly powerful and more numerous heavy artillery, and on the other hand a very light ordnance—trench mortars and infantry-cannon.

The heavy artillery is a mighty offensive arm. During rapid operations it will always be an impediment. Therefore we see the heavy artillery grow in importance, number, and caliber during the periods when fighting about fortified positions is general, as in the Spanish Succession Wars, during the campaigns of the Netherlands, and in the 18th Century. But it loses its value, is reduced and partly disappears when the warfare takes other forms, as during the times of Gustavus Adolphus, Napoleon and Moltke. Heavy artillery is a product of trench warfare and cannot alone bring a change in the mode of fighting.

This is proved by, among other things, the operations in Galicia and Poland in 1915. The great superiority of the Central Powers in heavy artillery crushed the Russian positions at Dunajetz and brought about open warfare; the superiority was great enough to break thru any new Russian defensive lines, but it did not succeed in preventing the Russians from gaining a firm footing in such positions. The advance of the artillery was too slow and the ammunition supply could not be replenished quickly enough. The same thing seems to have happened at Tolmein; the defeated Italian armies gained time to reorganize and to fortify the line of Piave before the artillery superiority of the two Allies could assert itself anew.

But not even during the fighting itself is the heavy artillery alone able to give the infantry all the support which it needs. The most numerous heavy artillery can not break the resistance of a movable, elastic defense. The field artillery can not solve this problem; the need of special artillery has brought about the use of trench mortars, mine throwers, the French 37 mm. infantry cannon, and the "pom-pom" of the Boer War—all artillery for fighting at close range. This arm seems to have great possibilities for a future development.

X. *The Mobility of the Army.*—This is a factor which might be subject to changes. At the scene of war, the mobility of the army is influenced by:

1. The mobility of the single units, their marching capacity and the kind of roads, their strength, organization and equipment of train.
2. The mode of procuring supplies.

The comparatively small trains of the armies of Napoleon have developed into the enormous trains of to-day. The question of finding a remedy for this is a difficult one. The elimination of the heavy arms from the army would not solve the question; in France the adoption of heavy artillery in the years just before the war was objected to. The result was not successful. It is of little use to be superior in evolutions when inferior in battle. The future will sooner bring increase than decrease of the matériel which the army will have to carry.

But because the army operating independently needs all this material, all its different units do not necessarily have to be equipped in the same way, neither its tactical units (battalions, regiments) nor its battle units (the divisions). The leader of the operations may have all the means possible at his disposal to wage war within a certain territory and at the same time his battle units may be very mobile. The scanty information from the present war seems to confirm development in this direction.

The organization of special mountain troops has been extended; there are mountain divisions and mountain corps as independent units which fight, march and live for long periods away from the highways.

The divisions have been made smaller; the German divisions seem to have nine battalions, one squadron, 48 guns and howitzers against twelve, four, and 72 before the war. In the other armies the proportion is the same. The tendency seems to be the following: The army will be the operating unit consisting of a number of infantry divisions, cavalry divisions, army artillery and other army troops, while the division is reduced to a battle unit, with limited independence but greater mobility than heretofore.

Regarding the army service, there is no information as to its organization in such an army. Before the war we had a very good example of a corresponding organization in the British Expeditionary Force, which stood the test during the enormously difficult retreat in 1914, when all of a sudden it had to change its lines of communication. The principles of this organization may prove valuable in the future.

Less unwieldy battle units can not be obtained unless the train is reduced; in any case the major part of the real baggage ought to be gathered and put further to the rear to be brought to the troops only during pauses in the operations and during marches. The tendency has hitherto been the opposite, to increase the train in order to meet the exigencies of better supply of provisions, better equipment of bivouac, and better sanitary conditions, all very just demands. A soldier must be treated well to keep up his strength and morale. The question is, however, not the well-being of the soldier; he can not escape hardships during war, in any case not during the critical periods of battle. The question ought to be put thus: Does it pay to provide well for the troops during the beginning of a battle, if thereby the mobility of the army is hampered so that the battle becomes a lengthy trench warfare with all its sacrifices and exertions? It would certainly be better to have these sacrifices and exertions before and after the battle and during the marches, in order to avoid trench warfare.

It is said that Napoleon's soldiers paid for his vic-

tories with their bloody feet, their hungry stomachs, and nights in the open. Their successors to-day would certainly gladly change with them and give up tents, woolen blankets and the rolling kitchens if they could thereby escape from the trenches.

—Military Situation

See also

RUSSIA—HISTORY

[Chronicle of the War. By A. *Memorial de Caballeria*, Oct, '17. 4200 words. 2 sketches.]

(The chronological account of the war which appears regularly in this Journal. The situation on Oct 1 is discussed in this number.) The conclusion is that from the military point of view the war is practically decided. Only the English persist in throwing their entire energies into the combat. The spirit of the warring peoples sustains the war but material forces do not respond to the desire. On both sides cities are bombarded by squadrons of aircraft. In this concept London has the sad supremacy as she has been repeatedly and copiously attacked by airplanes and Zeppelins. The situation on Oct 1 has changed but little from what it was on Sept 1 and Aug 1, except in regard to the failure of the power of resistance of Russia.

[How the War Will be Won. By Major Carlo Umberto Cattapani. *Marine Corps Gazette*, Dec, '17. 11,500 words.]

At the beginning of the fourth year of war we find two-thirds of the world combined against Germany and its allies. They have conquered about 200,000 square miles of foreign territory but have lost 1,000,000 square miles of prosperous colonies. They have enslaved Belgium, Poland, Serbia and part of Rumania, but sacrificed 2,000,000 of the flower of their manhood, at a cost of $20,000,000,000, and have acquired the hatred of the world.

On the Western front there are about 4,000,000 German soldiers, strongly intrenched, checked by the Allies, who are steadily but slowly pressing forward, constantly hammering at their foes who have lost the power of initiative.

Cadoma has countless numbers of men but needs help in heavy guns, which he expects to receive at any time from England and France. Germany knows this, and we must not be surprised if the next thrust will be delivered on the Alps, which, once crossed by our men, will leave open the road to Vienna and to the south of Germany.

The vital spots of Germany are in the west and south on the boundary line of Austria. On the west proper she is well protected, but in the south she has no formidable line of defense, as on the Rhine. Austria has her hands full with Italy and cannot spare a soldier.

We are not in a position to tell exactly what defenses have been prepared between the present German line and the Rhine, but observations made by airplanes and information recently received agree that long lines of mile-wide trench systems and other warlike works will form most formidable obstacles in the way of the advance. To attack and overcome this system of defense it will not be sufficient to leave an army in the proportion of two to one to the defending force. The Allies, to crush their foes and push on to Berlin, will have to possess a force of two and a half to one to break thru the Rhine. In order to defeat the Germany army of 4,000,000, the Allies must have 10,000,000, with a proper proportion of artillery of heavy caliber. However, this number may not be necessary if Germany can be threatened from the south and thereby compelled to withdraw part of her armies. In this case, at least 2,000,000 American soldiers must be forthcoming, which means that 4,000,000 men must be called to keep this contingent to the highest pitch of fighting efficiency.

The Central Powers are too big to be starved with our present system, and with the loose links of neutral nations in the chain of iron that is thrown around them America, in spite of the enormous destruction of ships, will be able to transport to France all her troops and matériel, with very few losses, as Canada has done.

Germany is destroying 10,000,000 tons of shipping a year, and the Allies are building 7,000,000. At this rate it would take Germany about ten years to prevent communication between the different groups of her enemies, if her efficiency could continue in the same ratio as at present and we were lacking in our productive capacity. Therefore we cannot count on shortening the war with the blockade, nor Germany with her submarine campaign.

[The German Effort in 1918. By Maj.-Gen. Sir F. Maurice, .C.M.G., C.B. *Army & Navy Gazette*, June 29, '18. 1300 words.]

Between October, 1917, and May, 1918, it is estimated that the Germans brought across from the eastern to the western front, forces little inferior in numbers to the armies which they mobilized against France in August, 1914, and in heavy guns and airplanes, greater. An advantage much greater is that these forces were probably well trained during the quiet of the eastern front. With armies in their present condition, training is everything. It has been stated that before the first offnsive of this year Germany had 90 divisions, of nine battalions each, in reserve, all of which had been thru a special course of training for attack. We and the French have never been able to keep sufficient divisions out of the line to train to anything approaching that extent. It is reasonable to regard the offensives of March and April as representing the maximum effort of which Germany is capable, as she can never again have such a reservoir to draw on as she had in the winter of 1917-18. We have been informed that, in the attacks of March and April on the Somme and in Flanders, the Germans employed about 150 divisions, many engaged twice, some three, and a few four times. In the third and fourth offensives of this year, the Germans are estimated to have employed 60 to 65 divisions. It is however, calculated that the Germans have available sufficient reserves to enable them to put in another attack about equal in power to the last two together.

EUROPEAN WAR—Continued

I believe one reason for the delay in their next effort is that the Germans do not wish to put in their new divisions until thoroly schooled. We are now half way thru the campaigning season of 1918, and the situation is that the enemy can deliver another heavy attack and that a much smaller advance than he has yet made, either in the direction of the Channel ports or on the Amiens front, or towards Paris, would place us in a position of great difficulty. Once we have tided over the time of preparation of the American Army, we must go up in strength and Germany down. We must see to it that we really learn from the hard lessons of this year and are never again too late. In future men must be found before, and not after, the emergency has arisen.

[The Enemy's Objective. *Army & Navy Gazette*, June 22, '18. 400 words.]

The Crown Prince might have made his principal effort against the Allied front between Dorman's and Rheims. If successful, he would have obstructed the Allied communications toward Verdun. As such advance would have been eccentric with his advance toward Amiens or the Oise Valley, he attacked westward toward Villers-Cotterets against the opposite face of the salient, revealing Paris as his probable object. Tactically, an advance towards Villers-Cotterets, if combined with an advance along the Oise valley, would menace with disaster all the Allied front between Soissons and Compiègne. The point of attack on Mar 21 was selected for tactical reasons. So probably was that of May 27, and also the direction of the enemy's push to the westward from the salient.

[Current Topics — the Steadying-down Process. Anon. *Arms and Explosives*, Sept 2, '18. 350 words.]

The favorable change in the military situation has revealed some unsuspected conditions of allied strength. Besides the benefits of unity of command, American aid, the extensive use of tanks and airplanes, inspection of newly won ground indicates a completeness of shell-searching greater than any to which our own lines have been subjected. Evidently the munitions effort is beginning to bear full fruit. Information at hand shows that the great loss of material incidental to the defeat of the Fifth Army was made up in a few weeks of special effort. The advisability of the demand for such an effort on the part of workers, who were already at top pressure, may be questioned; and was possibly responsible in part for our recent labor troubles.

—Mines

See

MINES, NAVAL—USE OF IN EUROPEAN WAR

—Naval Lessons of the

See also

EUROPEAN WAR—MILITARY LESSONS OF THE
SUBMARINES—DEFENSE AGAINST

—Naval Operations

See also

"KARLSRUHE," OPERATIONS OF THE

—Naval Power in

See also

GREAT BRITAIN—NAVY

—Peace Negotiations

[The Conditions of Victory. By Hilaire Belloc. *Land and Water*, Oct 25 and Nov 15, '17. 6000 words.]

The third part of the enemy's propaganda is the demand that the Allies should state specific terms of peace. The terms which the Allies will impose if they succeed in putting the Prussian military machine out of action are such as are not worth discussing with an undefeated Germany, because the existing Prussian machine will not sign its own death warrant.

The terms involve two fundamental propositions which an unbeaten Germany will never accept: 1st, the tremendous burden of material reparation; 2d, the moral indignity of seeing *individual punishment* meted out to the men responsible for particular crimes. They further involve the taking of guarantees for the carrying out of stipulations to which the mere word of the enemy in any form is worthless.

It is remarkable that the self-appointed arbitrators now advocating discussion of peace terms with Germany should always take as a "basis of negotiation" the claims of an undefeated Prussia. Unless victory be deemed absolutely impossible, to discuss the details of peace would be like discussing with a criminal what terms he will accept.

The rebuttal of the claim to detailed discussion of peace terms may be summed up by saying that of its three parts, no one will stand examination:

(1) It is not true that the German people are an oppressed majority hating cruel masters from whom it is the duty of the Allies to free them. They are one body and *they*, not their masters, made this war.

(2) The enemy's lines are not impregnable and to say that a decision against him is impossible is nonsense.

(3) This enemy cry for particular details of peace always presupposes *his* terms, not those of the Allies. His apologists, who propose a negotiated peace, invariably state the best case for *him*.

The demand for detailed discussion with the enemy should therefore be neglected.

The practical aim set before the Allied nations is the destruction of the Prussian military machine. If that cannot be done then the war is lost. If it can be done and *only* if it can be done shall the Allied nations be in the position to re-establish civilization securely for the future. Victory in the field is the first point. The second point, the practical fruit of such victory is best represented in the formula, "Restoration, reparation and guarantees."

Restoration signifies the giving up of those territories seized from the rightful owners as well as those long held against the will of their inhabitants by the present allies of Prussia.

Reparation is a claim subject to modification from two causes. First, that a great and indeterminate part of the damage done is inevitable even to legitimate war, and second, that the damage already illegitimately done probably exceeds the enemy's power of economic

reparation however severe the terms of the Allies might be able to impose. The principle is clear, however, that if European civilization wins, those who set out to subjugate it, having deliberately made terror their instrument, must, to their own impoverishment, be compelled to restore as much as is materially possible.

With reference to guarantees, the very first principle to seize is that the guarantees must be material or they are worthless. Territory must be occupied, persons held as hostages and lastly the enemy's shipping, now intact in his harbors, taken over.

The breaking of Prussian military power and all that is included in the words Restoration, Reparation and Guarantees would mean permanent security. An inconclusive peace would be for the moment a defeat of the Western Alliance and in its ultimate effect would amount only to an armed truce, probably of short duration.

[The Conditions of Victory. By Hilaire Belloc. *Land and Water*, Nov 22, '17. 2800 words.]

The Test of Poland

The first condition of victory is the fundamental military point that unless the enemy suffers military defeat, the Alliance itself is defeated—with all its objects.

Even tho that military result were achieved its fruit must be Restoration, Reparation and Guarantees.

But there is also in all this affair what is very important in any practical matter and that is a *test*. In this war a curiously simple test is afforded. It is the test of Poland.

What happens to Poland is the touchstone of the whole war. Poland, in some form or other, whether at the hands of the Germans or at the hands of the Allies, is now in active process of resurrection. A Polish State is about to be. With Poland organized in a German fashion and at Germany's bidding, all the East is under German influence. A German Poland, however veiled the German influence might be, would render secure the road to the East thru Constantinople for Vienna and Berlin. Such a dependent Poland would make the Baltic a completely German sea closed at the German pleasure.

Either the end of this war will see a Poland rearisen but part of and greatly strengthening the German conception of a Central European Group under Prussian domination—a Central Europe controlling the Baltic on the north and the road to the east upon the south; or there will be a Poland, much stronger, quite independent, acting as a counter-weight to the diminished and defeated Germanic Empires, claiming the right to trade freely with the West thru the Baltic, and so keeping the Baltic always open to the Western Powers; overhanging the Slav States of the south and so preventing German possession of the road thru the Balkans to the east; a beacon also to the Slavs of the Austrian Empire.

By that criterion victory or defeat may be judged. If the first part of Poland appears, the Allies are defeated. If the second, they are victorious.

[Diplomatic Exchanges Between Germany and the United States. *N. Y. Times* of equivalent dates, '18. Quoted.]

Text of German Note Proposing Peace Parley on the Basis of Wilson's Principles

Amsterdam, Oct 6 (Associated Press).—The text of the note forwarded by the Imperial German Chancellor, Prince Maximilian, to President Wilson, thru the Swiss Government, follows:

The German Government requests the President of the United States to take in hand the restoration of peace, acquaint all the belligerent States of this request, and invite them to send plenipotentiaries for the purpose of opening negotiations.

It accepts the program set forth by the President of the United States in his message to Congress on Jan 8, and in his later pronouncements, especially his speech of Sept 27, as a basis for peace negotiations.

With a view to avoiding further bloodshed, the German Government requests the immediate conclusion of an armistice on land and water and in the air.

Text of President's Note to Germany

Department of State,
Washington, D. C.,
Oct 8, 1918.

Sir: I have the honor to acknowledge, on behalf of the President, your note of Oct 6, enclosing a communication from the German Government to the President, and I am instructed by the President to request you to make the following communication to the Imperial Chancellor:

"Before making reply to the request of the Imperial German Government, and in order that that reply shall be as candid and straightforward as the momentous interests involved require, the President of the United States deems it necessary to assure himself of the exact meaning of the note of the Imperial Chancellor. Does the Imperial Chancellor mean that the Imperial German Government accepts the terms laid down by the President in his address to the Congress of the United States on the 8th of January last and in subsequent addresses, and that its object in entering into discussions would be only to agree upon the practical details of their application?

"The President feels bound to say with regard to the suggestion of an armistice that he would not feel at liberty to propose a cessation of arms to the Governments with which the Government of the United States is associated against the Central Powers so long as the armies of those Powers are upon their soil. The good faith of any discussion would manifestly depend upon the consent of the Central Powers immediately to withdraw their forces everywhere from invaded territory.

"The President also feels that he is justified in asking whether the Imperial Chancellor is speaking merely for the constituted authorities of the Empire who have so far conducted the war. He deems the answer to these questions vital from every point of view."

EUROPEAN WAR—Continued

Accept, Sir, the renewed assurances of my high consideration.

ROBERT LANSING.

To Mr. Frederick Oederlin, Chargé d'Affaires of Switzerland, ad interim, in charge of German interests in the United States.

Germany's Reply to the President

[Wirelessed from Nauen, picked up in France and cabled to Washington. The reply has not yet been transmitted thru the regular channels.]

BERLIN, Oct 12, '18.—In reply to the questions of the President of the United States of America, the German Government hereby declares:

The German Government has accepted the terms laid down by Prsident Wilson in his address of Jan 8 and in his subsequent addresses on the foundation of a permanent peace of justice. Consequently its object in entering into discussion would be only to agree upon practical details of the application of these terms. The German Government believes that the Government of the powers associated with the Government of the United States also take the position taken by President Wilson in his address.

The German Government, in accordance with the Austro-Hungarian Government, for the purpose of bringing about an armistice, declares itself ready to comply with the proposition of the President in regard to evacuation. The German Government suggests that the President may occasion the meeting of a mixed commission for making the necessary arrangements concerning the evacuation.

The present German Government, which has undertaken the responsibility for this step toward peace, has been formed by conferences and in agreement with the great majority of the Reichstag. The Chancellor, supported in all his actions by the will of this majority, speaks in the name of the German Government and of the German people.

(Signed) SOLF,

State Secretary of Foreign Office.

President Wilson's Reply to the German Government

Department of State,
Washington, Oct 14, '18.

Sir: In reply to the communication of the German Government, dated the 12th inst., which you handed me to-day, I have the honor to request you to transmit the following answer:

The unqualified acceptance by the present German Government and by a large majority of the German Reichstag of the terms laid down by the President of the United States of America in his address to the Congress of the United States on the 8th of January, 1918, and in his subsequent addresses justifies the President in making a frank and direct statement of his decision with regard to the communications of the German Government of the 8th and 12th of October, 1918.

It must be clearly understood that the process of evacuation and the conditions of an armistice are matters which must be left to the judgment and advice of the military advisers of the Government of the United States and the allied Governments, and the President feels it his duty to say that no arrangement can be accepted by the Government of the United States which does not provide absolutely satisfactory safeguards and guarantees of the maintenance of the present military supremacy of the armies of the United States and of the Allies in the field. He feels confident that he can safely assume that this will also be the judgment and decision of the Allied Governments.

The President feels that it is also his duty to add that neither the Government of the United States nor, he is quite sure, the Governments with which the Government of the United States is associated as a belligerent will consent to consider an armistice so long as the armed forces of Germany continue the illegal and inhumane practices which they persist in.

At the very time that the German Government approaches the Government of the United States with proposals of peace, its submarines are engaged in sinking passenger ships at sea, and not the ships alone, but the very boats in which their passengers and crews seek to make their way to safety; and in their present inforced withdrawal from Flanders and France the German armies are pursuing a course of wanton destruction which has always been regarded as in direct violation of the rules and practices of civilized warfare. Cities and villages, if not destroyed, are being stripped of all they contain not only, but often of their very inhabitants. The nations associated against Germany cannot be expected to agree to a cessation of arms while acts of inhumanity, spoilation, and desolation are being continued which they justly look upon with horror and with burning hearts.

It is necessary also, in order that there may be no possibility of misunderstanding, that the President should very solemnly call the attention of the Government of Germany to the language and plain intent of one of the terms of peace which the German Government has now accepted. It is contained in the address of the President delivered at Mount Vernon on the Fourth of July last. It is as follows:

"The destruction of every arbitrary power anywhere that can separately, secretly, and of its single choice disturb the peace of the world; or, if it cannot be presently destroyed, at least its reduction to virtual impotency."

The power which has hitherto controlled the German nation is of the sort here described. It is within the choice of the German nation to alter it. The President's words, just quoted, naturally constitute a condition precedent to peace, if peace is to come by the action of the German people themselves. The President feels bound to say that the whole process of peace will, in his judgment, depend upon the definiteness and the satisfactory character of the guarantees which can be given in this fundamental matter. It is indispensable that the Governments associated against Germany should know beyond a peradventure with whom they are dealing.

The President will make a seperate reply to the Royand and Imperial Government of Austria-Hungary.

Accept, Sir, the renewed assurance of my high consideration.

(Signed) ROBERT LANSING.

Mr. Frederick Oederlin, Chargé d'Affaires of Switzerland, ad interim in charge of German interests in the United States.

Text of Germany's Reply to President Wilson

LONDON, Oct 21.—The text of the German note in reply to President Wilson, as received by wireless, is as follows:

In accepting the proposal for an evacuation of occupied territory the German Government has started from the assumption that the procedure of this evacuation and of the conditions ot an armistice should be left to the judgment of the military advisers and that the actual standard of power on both sides in the field has to form the basis for arrangements safeguarding and guaranteeing this standard..

The German Government suggests to the President that an opportunity should be brought about for fixing the details. It trust that the President of the United States will approve of no demand which would be irreconcilable with the honor of the German people and with opening a way to a peace of justice.

The German Government protests against the reproach of illegal and inhumane actions made against the German land and sea forces and thereby against the German people. For the covering of a retreat, destructions will always be necessary, and they are carried out in so far as is permitted by international law. The German troops are under the most strict instruction to spare private property and to exercise care for the population to the best of their ability. Where transgressions occur in spite of these instructions the guilty are being punished.

The German Government further denies that the German Navy in sinking ships has ever purposely destroyed lifeboats with their passengers. The German Government proposes with regard to all those charges that the facts be cleared up by neutral commissions.

In order to avoid anything that might hamper the work of peace, the German Government has caused orders to be dispatched to all submarine commanders, precluding the torpedoing of passenger ships, without, however, for technical reasons, being able to guarantee that these orders will reach every single submarine at sea before its return.

As a fundamental condition for peace the President prescribes the destruction of every arbitrary power that can separately, secretly, and of its own single choice disturb the peace of the world. To this the German Government replies:

Hitherto the representation of the people in the German Empire has not been endowed with an influence in the formation of the Government.

The Constitution did not provide for a concurrence of representation of the people in decisions of peace and war. These conditions have just now undergone a fundamental change. A new Government has been formed in complete accordance with the wishes (principle?) of the representation of the people, based on equal, universal, secret, direct franchise.

The leaders of the great parties of the Reichstag are members of this Government. In the future no Government can take or continue in office without possessing the confidence of a majority of the Reichstag.

The responsibility of the Chancellor of the empire to the representation of the people is being legally developed and safeguarded. The first act of the new government has been to lay before the Reichstag a bill to alter the Constitution of the Empire so that the consent of the representation of the people is required for decisions on war and peace.

The permanence of the new system is, however, guaranteed not only by constitutional safeguards, but also by the unshakeable determination of the German people, whose vast majority stands behind these reforms and demands their energetic continuance.

The question of the President—with whom he and the Goverments associated against Germany are dealing—is therefore answered in a clear, unequivocal manner by the statement that the offer of peace and an armistice has come from a Government which is free from any arbitrary and irresponsible influence, is supported by the approval of an overwhelming majority of the German people.

SOLF.

Text of President Wilson's Reply to the German Government

Department of State,
Washington, D. C.,
Oct 23, '18.

Sir: I have the honor to acknowledge the receipt of your note of the 22d transmitting a communication under date of the 20th from the German Government and to advise you that the President has instructed me to reply thereto as follows:

Having received the solemn and explicit assurance of the German Government that it unreservedly accepts the terms of peace laid down in his address to the Congress of the United States on the 8th of January, 1918, and the principles of settlement enunciated in his subsequent addresses, particularly the address of the 27th of September, and that it desires to discuss the details of their application, and that this wish and purpose emanate, not from those who have hitherto dictated German policy and conducted the present war on Germany's behalf, but from Ministers who speak for the majority of the Reichstag and for an overwhelming majority of the German people; and having received also the explicit promise of the present German Government that the humane rules of civilized warfare will be observed both on land and sea by the German armed forces, the President of the United States feels that he cannot decline to take up with the Governments with which the Government of the United tSates is associated the question of an armistice.

He deems it his duty to say again, however, that the only armistice he would feel justified in submitting for consideration would be one which should leave the United States and the Powers associated with her in a position to enforce any arrangements that may be en-

EUROPEAN WAR—Continued
tered into and to make a renewal of hostilities on the part of Germany impossible.

The President has, therefore, transmitted his correspondence with the present German authorities to the Governments with which the Government of the United States is associated as a belligerent, with the suggestion that, if those Governments are disposed to effect peace upon the terms and principles indicated, their military advisers and the military advisers of the United States be asked to submit to the Governments associated against Germany the necessary terms of such an armistice as will fully protect the interests of the peoples involved and insure to the associated Governments the unrestricted power to safeguard and enforce the details of the peace to which the German Government has agreed, provided they deem such an armistice possible from the military point of view. Should such terms of armistice be suggested, their acceptance by Germany will afford the best concrete evidence of her unequivocal acceptance of the terms and principles of peace from which the whole action proceeds.

The President would deem himself lacking in candor did he not point out in the frankest possible terms the reason why extraordinary safeguards must be demanded. Significant and important as the Constitutional changes seem to be which are spoken of by the German Foreign Secretary in his note of the 20th of October, it does not appear that the principle of a Government responsible to the German people has yet been fully worked out or that any guarantees either exist or are in contemplation that the alterations of principle and of practice now partially agreed upon will be permanent. Moreover, it does not appear that the heart of the present difficulty has been reached. It may be that future wars have been brought under the control of the German people, but the present war has not been; and it is with the present war that we are dealing. It is evident that the German people have no means of commanding the acquiescence of the military authorities of the Empire in the popular will; that the power of the King of Prussia to control the policy of the Empire is unimpaired; that the determining initiative still remains with those who have hitherto been the masters of Germany. Feeling that the whole peace of the world depends now on plain speaking and straightforward action, the President deems it his duty to say, without any attempt to soften what may seem harsh words, that the nations of the world do not and cannot trust the word of those who have hitherto been the masters of German policy, and to point out once more that in concluding peace and attempting to undo the infinite injuries and injustices of this war the Government of the United States cannot deal with any but veritable representatives of the German people who have been assured of a genuine Constitutional standing as the real rulers of Germany.

If it must deal with the military masters and the monarchical autocrats of Germany now, or if it is likely to have to deal with them later in regard to the international obligations of the German Empire, it must demand, not peace negotiations, but surrender. Nothing can be gained by leaving this essential thing unsaid.

Accept, Sir, the renewed assurance of my high consideration.

(Signed) ROBERT LANSING.

Mr. Frederick Oederlin, Chargé d'Affaires of Switzerland, ad interim in charge of German intersts in the United States.

Text of Germany's Reply to President Wilson

COPENHAGEN, Oct 27 (Associated Press).—Germany's answer to President Wilson's latest communication says:

The German Government has taken cognizance of the answer of the President of the United States.

The President is aware of the far-reaching changes which have been carried out and are being carried out in the German constitutional structure, and that peace negotiations are being conducted by a People's Government, in whose hands rests, both actually and constitutionally, the power to make the deciding conclusions. The military powers are also subject to it.

The German Government now awaits proposals for an armistice, which shall be the first step toward a just peace, as the President has described it in his proclamation.

SOLF.

[Diplomatic Exchanges between Austria-Hungary and the United States. *N. Y. Times* of equivalent dates, '18. Quoted.]

Official Text of the Note from Austria-Hungary

Legation of Sweden,
Washington, D. C.,
Oct 7, '18.

[Translation.]

Excellency:

By order of my Government I have the honor confidentially to transmit herewith to you the following communication of the Imperial and Royal Government of Austria-Hungary to the President of the United States of America:

The Austro-Hungarian Monarchy, which has waged war always and solely as a defensive war and repeatedly given documentary evidence of its readiness to stop the shedding of blood and to arrive at a just and honorable peace, hereby addresses itself to his Lordship, the President of the United States of America, and offers to conclude with him and his Allies an armistice on every front on land, at sea, and in the air, and to enter immediately upon negotiations for a peace for which the fourteen points in the message of President Wilson to Congress of Jan 8, '18, and the four points contained in President Wilson's address of Feb 12, '18, should serve as a foundation, and in which the viewpoints declared by President Wilson in his address of Sept 27, '18, will also be taken into account.

Be pleased to accept, &c.,

(Signed) W. A. F. EKENGREN.

His Excellency, Mr. Robert Lansing, Secretary of State of the United States, Washington.

Text of President's Note to Austria-Hungary

Department of State,
Washington, D. C.,
Oct 19, '18.

Sir:

I have the honor to acknowledge the receipt of your note of the seventh instant in which you transmit a communication of the Imperial and Royal Government of Austria-Hungary to the President. I am now instructed by the President to request you to be good enough thru your Government to convey to the Imperial and Royal Government the following reply:

The President deems it his duty to say to the Austro-Hungarian Government that he cannot entertain the present suggestion of that Government because of certain events of utmost importance, which, occurring since the delivery of his address of the 8th of January last, have necessarily altered the attitude and responsibility of the Government of the United States. Among the fourteen terms of peace which the President formulated at that time, occurred the following:

"X.—The people of Austria-Hungary, whose place among the nations we wish to see safeguarded and assured, should be accorded the freest opportunity of autonomous development."

Since that sentence was written and uttered to the Congress of the United States, the Government of the United States has recognized that a state of belligerency exists between the Czechoslovaks and the German and Austro-Hungarian Empires and that the Czechoslovak National Council is a de facto belligerent Government clothed with proper authority to direct the military and political affairs of the Czechoslovaks. It has also recognized in the fullest manner the justice of the nationalistic aspirations of the Jugo-Slavs for freedom.

The President is, therefore, no longer at liberty to accept the mere "autonomy" of these peoples as a basis of peace, but is obliged to insist that they, and not he, shall be the judges of what action on the part of the Austro-Hungarian Government will satisfy their aspirations and their conception of their rights and destiny as members of the family of nations.

Accept, Sir, the renewed assurances of my highest consideration.

(Signed) Robert Lansing.

Text of the Austrian Note Replying to President Wilson

Basle, Oct 28.—The Austro-Hungarian Foreign Minister instructed the Austro-Hungarian Minister at Stockholm yesterday to ask the Swedish Government to send the following note to the Washington Government:

Vienna, Oct 28.

In reply to the note of President Wilson of the 19th of this month, addressed to the Austro-Hungarian Government and giving the decision of the President to speak directly with the Austro-Hungarian Government on the question of an armistice and of peace, the Austro-Hungarian Government has the honor to declare that equally with the preceding proclamations of the President, it adheres also to the same point of view contained in the last note upon the rights of the Austro-Hungarian peoples, especially those of the Czechoslovaks and the Jugoslavs.

Consequently, Austria-Hungary accepting all the conditions the President has laid down for the entry into negotiations for an armistice and peace, no obstacle exists, according to the judgment of the Austro-Hungarian Government, to the beginning of these negotiations.

The Austro-Hungarian Government declares tiself ready, in consequence, without awaiting the result of other negotiations, to enter into negotiations upon peace between Austria-Hungary and the States in the opposing group and for an immediate armistice upon all Austro-Hungarian fronts.

It asks President Wilson to be so kind as to begin overtures on this subject.

Andrassy.

—Peace Negotiations—Armistice Terms

Austria-Hungary

[Terms of Armistice Imposed upon Austria-Hungary. *Official Bulletin,* Nov 4, '18. Quoted.]

Following are the terms of the armistice imposed upon Austria, which went into effect at 3 o'clock Nov 4:

Military Clauses

One.—The immediate cessation of hostilities by land, sea, and air.

Two.—Total demobilization of the Austro-Hungarian army and immediate withdrawal of all Austro-Hungarian forces operating on the front from the North Sea to Switzerland.

Within Austro-Hungarian territory, limited as in clause 3 below, there shall only be maintained as an organized military force a (?), reduced to pre-war effectives (effectiveness?).

Half the divisional, corps, and army artillery and equipment shall be collected at points to be indicated by the Allies and United States of America for delivery to them, beginning with all such material as exists in the territory to be evacuated by the Austro-Hungarian forces.

Three.—Evacuation of all territories invaded by Austro-Hungary since the beginning of war. Withdrawal within such periods as shall be determined by the commander in chief of the allied forces on each front of the Austro-Hungarian armies behind a line fixed as follows: From Pic Umbrail to the north of the Stelvio it will follow the crest of the Rhetian Alps up to the sources of the Adige and the Eisach, passing thence by Mounts Rescshen and Brenner and the heights of Oetz and Zoaller. The line thence turns south, crossing Mount Toblach and meeting the present frontier Carnic Alps. It follows this frontier up to Mount Tarvis, and after Mount Tarvis the watershed of the Julian Alps by the Col of Predil, Mount Mangart, the Tricorno (Terglou), and the watershed of the Cols di Podberdo, Podlaniscam and Idria. From this point the line turns southeast toward the Schnee-

EUROPEAN WAR—Continued

berg, excludes the whole basin of the Save and its tributaries. From Schneeberg it goes down toward the coast in such a way as to include Castua, Mattuglia, and Volosca, in the evacuated territories.

It will also follow the administrative limits of the present Province of Dalmatia, including to the north Lisarica and Trivania and, to the south, territory limited by a line from the (Semigrand?) of Cape Planca to the summits of the watershed eastward, so as to include in the evacuated area all the valleys and watercourses flowing toward Sebenico, such as the Cicola, Kerka, Butisnica, and their tributaries. It will also include all the islands in the north and west of Dalmatia from Premuda, Selve, Ulbo, Scherda, Maon, Pago, and Puntadura in the north up to Meleda in the south, embracing Santandrea, Busi, Lisa, Lesina, Tercola, Curzola, Cazza, and Lagosta, as well as the neighboring rocks and islets and passages, only excepting the islands of Great and Small Zirona, Bua, Solta, and Brazza. All territory thus evacuated (shall be occupied by the forces?) of the Allies and of the United States of America.

All military and railway equipment of all kinds, including coal belonging to or within those territories, (to be?) left in situ and surrendered to the allies according to special orders given by the commander in chief of the forces of the associated powers on the different fronts. No new destruction, pillage or requisition to be done by enemy troops in the territries to be evacuated by them and occupied by the forces of the associated powers.

Four.—The Allies shall have the right of free movement over all road and rail and waterways in Austro-Hungarian territory and of the use of the necessary Austrian and Hungarian means of transportation. The armies of the associated powers shall occupy such strategic points in Austria-Hungary at times as they may deem necessary to enable them to conduct military operations or to maintain order.

They shall have the right of requisition on payment for the troops of associated powers (wherever?) they may be.

Five.—Complete evacuation of all German troops within fifteen days not only from the Italian and Balkan fronts but from all Austro-Hungarian territory.

Internment of all German troops which have not left Austria-Hungary within the date.

Six.—The administration of the evacuated territories of Austria-Hungary will be entrusted to the local authorities under the control of the allied and associated armies of occupation.

Seven.—The immediate repatriation without reciprocity of all allied prisoners of war and interned subjects and of civil populations evacuated from their homes on conditions to be laid down by the commander in chief of the forces of the associated powers on the various fronts. Sick and wounded who can not be removed from evacuated territory will be cared for by Austria-Hungary personnel, who will be left on the spot with the medical material required.

Naval Conditions

One.—Immediate cessation of all hostilities at sea and definite information to be given as to the location and movements of all Austro-Hungarian ships.

Notification to be made to neutrals that freedom of navigation in all territorial waters is given to the naval and mercantile marine of the allied and associated powers, all questions of neutrality being waived.

Two.—Surrender to Allies and the United States of 15 Austro-Hungarian submarines completed between the years 1910 and 1918 and of all German submarines which are in or may hereafter enter Austro-Hungarian territorial waters. All other Austro-Hungarian submarines to be paid off and completely disarmed and to remain under the supervision of the Allies and United States.

Three.—Surrender to Allies and United States with their complete armament and equipment of 3 battleships, 3 light cruisers, 9 destroyers, 12 torpedo boats, 1 mine layer, 6 Danube monitors to be designated by the Allies and United States of America. All other surface warships, including river craft, are to be concentrated in Austro-Hungarian naval bases to be designated by the Allies and United States of America, and are to be paid off and completely disarmed and placed under the supervision of Allies and United States of America.

Four.—Freedom of navigation to all warsnips and merchant ships of allied and associated powers to be given in the Adriatic and up the River Danube and its tributaries in the territorial waters and territory of Austria-Hungary.

The allies and associated powers shall have the right to sweep up all mine fields and obstructions and the positions of these are to be indicated.

In order to insure the freedom of navigation on the Danube the Allies and the United States of America shall be empowered to occupy or to dismantle all fortifications or defense works.

Five.—The existing blockade conditions set up by the allied and associated powers are to remain unchanged and all Austria-Hungarian merchant ships found at sea are to remain liable to capture, save exceptions which may be made by a commission nominated by the Allies and the United States of America.

Six.—All naval air craft are to be concentrated and impactionized in Austro-Hungarian bases to be designated by the Allies and the United States of America.

Seven.—Evacuation of all the Italian coasts and of all ports occupied by Austria-Hungary outside their national territory and the abandonment of all floating craft, naval materials, equipment, and materials for inland navigation of all kinds.

Eight.—Occuption by the Allies and the United States of America of the land and sea fortifications and the islands which form the defenses and of the dockyards and arsenal at Pola.

Nine.—All merchant vessels held by Austria-Hungary belonging to the Allies and associated powers to be returned.

Ten.—No destruction of ships or of materials to be permitted before evacuation, surrender, or restoration.

Eleven.—All naval and mercantile marine prisoners of the allied and associated powers in Austro-Hungarian hands to be returned without reciprocity.

—Prisoners

[International Law. The Exchange and Internment of Prisoners. By Capt. Poblete. *Memorial del Ejército de Chile,* Oct, '17. 2300 words.]

(This article discusses the proposals submitted to the belligerents by the International Committee of the Red Cross of Geneva for the exchange and internment of prisoners of war. In addition to such agreements as are now in effect with reference to the repatriation or internment of disabled prisoners, a further, more liberal arrangement is proposed as follows: Prisoners of the following categories who have suffered over 18 months of captivity will be repatriated without reference to number. (1) All sub-officers, corporals and soldiers over 48 years of age. (2) All sub-officers, corporals and soldiers over 40 years of age who are fathers of three or more children.

The sub-officers, corporals and soldiers not included in the anterior categories to be exchanged person for person, grade for grade, and in order according to date of capture.)

[About 5000 Germans Interned in U. S.; 349 American Prisoners in Germany. *Official Bulletin,* June 8, '18. Quoted.]

The following statement is authorized by the War Department:

Latest records of the War Department show that a total of 133 American soldiers have been located at German prison camps. There also are 216 American civilians, including sailors, who are interned in Germany.

About 5000 Germans are interned in this country. This includes 1310 prisoners of war at Fort McPherson, Ga., most of whom were seamen on German ships; 839 alien enemies at Fort Oglethorpe, Ga.; 432 alien enemies at Fort Douglas, Utah; and between 2000 and 2500 prisoners taken from German merchantmen, at Hot Springs, N. C., at present under the Department of Labor.

Five hundred Germans interned in this country are being sent to army camps to aid in cultivating gardens. One hundred of them go to Camp Devens, 100 to Camp Grant, 100 to Camp Sevier, 100 to Camp Wadsworth, and 100 to Camp Sherman.

Great Britain

[Note. *Canadian Military Gazette,* Dec 11, '17. 54 words.]

According to figures given out by the War Office the British captured on all fronts in the month of November 26,869 prisoners and 221 guns. Of these 11,551 men and 138 guns were taken on the Western front, 10,454 men and 80 guns in Palestine, and 4403 men and 3 guns in East Africa.

—Relations with Neutrals

United States

See also
Monroe Doctrine

—Sanitary Service

[Medico-Military Notes. By Maj. R. W. Hinds, M.C., N.G.U.S. *Military Surgeon,* Feb, '18. 4300 words.]

(This is the final instalment of the writer's articles based upon his experience with the American Red Cross in the Belgian hospital at La Panne. Much of this instalment is taken up with a discussion of gas gangrene. There are also included a number of miscellaneous notes on hospital equipment, and the equipment and care of troops.)

[Notes Afield. By a Medical Observer. *Military Surgeon,* Apr, '18. 3500 words.]

(An interesting collection of notes gathered during an inspection of a number of French and British hospitals. The notes are presented with little attempt toward securing a connected chain of thought, but are very evidently a transcript of those points which impressed the observer at the time. The article presents a great deal of timely and valuable information, but the notes are already so brief that further condensation is impracticable.)

[Notes Afield. Notes of Interest Gathered During a Tour of Several British and French Hospitals in the District of ——. By a Military Observer. *Military Surgeon,* Apr, '18. 3500 words.]

In many of the hospitals the Carrel-Dakin solution is the universally used method of treatment for all infected wounds and also as a prophylactic treatment for all wounds of which the slightest doubt is entertained. Punctured wounds are converted into incised wounds, all badly bruised tissue is excised and Carrel-Dakin solution is started at once. Plenty of rubber tubing must be used and the skin surfaces around the wounds well protected by vaselined gauze. It must be remembered that the Carrel-Dakin tubes are used to bring the solution in contact with every portion of the wound and are not used in any sense as drainage tubes. The solution is used at room temperature and not by the so-called drop method.

Bacterial counts are made daily or every other day until the number of micro-organisms are reduced to one-half to a field. When this time arrives, normal saline, or artificial serum as the French call it, may be substituted for the Carrel-Dakin solution. In some cases the wound is sutured at this time with very satisfactory results. Some of the British hospitals use a paste made of iodoform, bismuth and vaseline "(B.I.P.)" as a dressing following the Carrel-Dakin treatment.

Some very beautiful examples of color photography and ordinary photography with the use of the yellow filter, were observed. Very few end-results were seen because of the necessity of evacuating the hospitals as soon as patients can be transported comfortably to England for convalescence.

EUROPEAN WAR—Continued

The hospital trains as used by the British are models of completeness and sanitary excellence. They consist of passenger coaches of the finest type, more like the American car than anything else seen on this side of the water. The ordinary hospital train consists of one car with compartments for the commanding officer, his one or two assistants and the nursing sisters along with a mess and bathing facilities for each group; an operating and dressing room car, a car for baggage and supplies, a varying number of ordinary coaches for the ambulant patients and coaches provided with racks on which the stretchers containing the recumbent patients are placed. These racks are so constructed that three tiers of stretchers can be accommodated on either side of the aisle.

One of these hospital trains will accommodate as many as 500 or 600 patients. A patient is never removed from the stretcher from the time he is placed in the ambulance at the evacuating point until his reception on the hospital ship and in some cases until his arrival at the convalescent hospital in England. The skill, ease and rapidity with which patients are handled is remarkable, and the happy expressions on the faces of even the severely wounded and seriously ill are the best evidence of the satisfactory manner in which the transportation of the sick and wounded is being carried out.

The hospital ships are equipped in much the same manner as the hospital trains, large wards taking the places of the rack cars.

The Carrel-Dakin treatment is carried on in hospital trains and ships just as carefully as in stationary hospitals. Minor operations and dressings are done with great success in the operating rooms of both classes of invalid transport.

The majority of the cases in the hospitals in this district are medical rather than surgical, the proportion being about 60 to 40 per cent. The average stay of the patient in the hospital is about 8 to 10 days. The principal diseases found are trench fever, pyrexia (of unknown origin), pneumonia, pleurisy, gas infection, gastroenteric infections, kidney and heart diseases and other diseases as met in civil practice.

Surgical Notes

One thing which has impressed the observer in his tour of the hospitals has been the fine team work between the various medical offiers as observed everywhere and nowhere to better advantage than in British General Hospital No. —, at ——, which is manned by American medical personnel. The American base hospital unit, as organized at present, has a well-balanced medical staff representing all of the specialties. This has been taken advantage of in the treatment of all patients so that each specialist is thus enabled to give his best efforts to those to whom his services are of the greatest value, and at the same time bear his share of the routine ward work which is cared for by all.

While our hospital units were organized primarily to care for 500 patients, unusually heavy convoys have increased the number of patients to over twice the original capacity. Experience has proven that the number of medical officers—namely, 26 to 28—is sufficient even for the increased number of patients cared for at times, but both the nursing and enlisted staffs are inadequate to the demands thrown upon them. Instead of 65 nurses, 100 would be the proper number to give adequate nursing service with justice both to patient and nurse, while 50 additional enlisted men would be able to care for the extra 500 patients without difficulty.

The utilization of railroad stations, hotels and other large buildings has worked out in a very satisfactory manner. Most of the buildings seen by the observer have been wonderfully well adapted to hospital purposes. Extra ward space has been provided by the building of temporary huts accommodating from 20 to 40 patients each.

Separate hospital buildings are provided for sick and injured officers and also in a large center like —— a special hospital is operated for sick nursing sisters.

Isolation hospitals and convalescent camps also serve their useful needs, and a new convalescent hospital capable, I understand, of accommodating up to 40,000 patients, is now being built by the British at ——.

A surgical ward containing from 40 to 80 beds is in charge of a senior and a junior medical officer and a supervising nurse with three assistants. The usual hours for nurses' duty are from 7:30 a. m. to 8 p. m. with a half-hour off for noon-meal, breakfast being taken before going on duty and dinner when coming off duty in the evening. If work is light, an hour for recreation is allowed in the latter part of the afternoon. In British General Hospital No. — at —— a number of nurses' aides, having from one to two years' experience, are utilized and give great satisfaction. They do everything for the patients except surgical dressings and administration of medicines and relieve the graduate nurses of a great deal of work thus allowing them to assist the surgeons in doing surgical dressings.

When a convoy arrives from the front, patients are taken from the hospital train to the hospital usually in motor ambulances, are sorted out according to their field diagnosis cards, allowed to rest for a couple of hours and then each case is bathed carefully, dressed and a more definite diagnosis made. Unless operation or X-ray is very urgent these are put off until the following day. All patients receive a preliminary dose of 500 units of antitetanic serum at the casualty clearing station and a second dose in the hospital in from six to ten days from the time of the first injection.

A wound, whether sutured or not, which presents local tenderness and infiltration, even tho it is not edematous and visibly infected, is incised at once and the incision carried thru fascia or aponeurosis so as to allow the muscle to bulge freely. Carrel-Dakin treatment is started at once as a prophylactic measure. Many wounds of large size are not Carreled but are exposed to sunlight with great success. A large shell wound of the thigh or buttock, for instance, will be given all the sunlight the patient can stand by moving his cot to the most exposed location, shading his face and covering the part with mosquito bar. This treatment is also very efficacious for extensive burns.

In the dressing of painful wounds a very valuable

method of anesthetizing the patient is used without danger even tho required daily. The formula of the anesthetic is as follows: Ethyl chloride, 5 c.c.; chloroform, 1 c.c.; ether, 24 c.c. A piece of flannel cloth is saturated with the entire amount and placed over the patient's face, this covered with another piece of flannel, and this in turn covered with oiled silk containing a small aperture, fitting over the nostrils. This is tied around the patient's face with a bit of tape or rubber tubing. The anesthesia produced will last for ten minutes and the dressing can be started on the second breath. This anesthesia is apparently devoid of danger, is not accompanied by unpleasant complications, is followed by no deleterious after-effects, and is welcomed by the patient.

The officer of the day attends to all emergencies, but it has been found of great value to have him call the physician or surgeon in charge of the ward if a severe hemorrhage or unusual emergency arises at night. The officer of the day occupies a special bedroom at night which is known to every one, so that no time is lost in reaching him if needed.

In all of the hospitals visited, both French and English, the supply of anesthetics, instruments and paraphernalia generally seemed to be ample.

The food in all hospitals was of good variety, quantity ample, and its preparation very satisfactory.

In hospitals not housed in permanent buildings, both wooden huts and canvas tents of various types are utilized. It has been observed that canvas tents, with double walls allowing an air space of 4 to 6 inches between, are much warmer than wooden huts.

It was noted with interest that, in the disposal of garbage and kitchen refuse, every effort is made to save all of the fats and drippings. As these are separated from the rest of the garbage they are run into tanks containing water, which is slowly and constantly changing. The fat rises to the surface of the water and at intervals is skimmed off, gathered up, and saved for glycerine-making. The rest of the garbage is incinerated.

In some places large settling pits are dug and are filled with old tin cans which have been previously flamed. Wash water and other liquid refuse from laundries and kitchens are allowed to drain into the ground thru these pits.

Nothing has been observed in any of the hospitals, barracks or camps visited which in any way can compare with the latrines as devised and used by the American Army. There has apparently been no attempt made in either British or French latrine construction to render the same fly-tight. Incineration of the feces is the method of disposal and, while it in itself is undoubtedly very satisfactory, it involves an unnecessary amount of labor in the cleaning out of latrine cans and conveying of this material to the incinerators. A disagreeable and unhealthy stench is produced during the whole process which is entirely obviated by the method of the American Army. The same criticism applies to urinals. The urinals observed usually consisted of ordinary galvanized iron or tin troughs which receive no other attention than an occasional flushing. The use of lamp black, asphaltum or coal oil is apparently unknown in these medical services.

The de-lousing stations, which are important adjuncts of every hospital, consist of portable steam-sterilizing outfits into which the clothing of new patients is placed. All clothes are subjected to steam sterilization at 215 deg. F. for one hour to an hour and a quarter and then allowed to dry out in the sterilized for 40 minutes thereafter.

Some hospitals have been achieving very satisfactory results in the treatment of infected wounds, particularly of joints and sinuses, by the injection of Eusol, which is a solution of chlorinated soda somewhat similar to the Carrel-Dakin solution but of greater germicidal power. This is injected directly into the diseased area every two hours or thru tubes, the same as the Carrel-Dakin solution.

In some institutions ether was the anesthetic of choice, while in others, nitrous oxide and oxygen was the anesthetic most frequently used. This was true particularly of British General Hospital No. —, where a very ingenious portable anesthetic outfit devised in Cleveland, Ohio, rendered the administration of the gas very satisfactory.

In all of the hospitals visited it has been noted that the X-ray outfits are of antiquated design and sufficient electric current is not available to achieve satisfactory results, particularly in cases where time is important. Radiographic diagnosis of cranial injuries or of conditions n the abdominal cavity are made with more difficulty than should be necessary. It is hoped that in the American hospitals the extreme importance of the very best apparatus and sufficient current be recognized in order that much better work may be accomplished.

One thing noted by the observer has been the amount of unnecessary surgery and after-treatment, as well as undue prolongaton of hospital confinement and subsequent unnecessary absence from the line, a large part of which could be avoided. This is due to too much unnecessary suturing of wounds in the casualty clearing stations.

While it is recognized that hemorrhage must be checked, sometimes by ligature and again by suture, immediate closure of wounds in these stations is to be severely condemned. Many infected wounds, seen by the observer, have required immediate reopening, removal of sutures and Carrel or similar treatment, because of the stitching done in the casualty clearing stations.

A great deal of unnecessary time and labor is spent in work which only has to be undone and which really is to the detriment of the patient. In many cases wounds should be enlarged and packed instead of closed, in order to afford opportunity for cleansing and drainage. The minimum amount of suturing consistent with safety from hemorrhage should be employed. Any further treatment of the wound should be left to the hospitals farther back from the line. As suturing takes time and material, this work is not only unnecessary but harmful and is a break in the chain of efficiency which should obtain in our system of medical relief.

Troops landing in France after being confined on board ship and in camp for several weeks, are very apt,

EUROPEAN WAR—Continued

when allowed leave, to succumb to the temptations which beset them, particularly in a country like France. The experience of the British Army has demonstrated the number of venereal diseases encountered among their troops is very large, and very elaborate hospital arrangements have been made for the treatment of officers and men suffering from these diseases.

British General Hospital No. — is a large institution of over 3000 beds devoted entirely to the treatment of syphilis, gonorrhea and chancroid. Four hundred of these beds are for officers. This is one of four similar hospitals conducted by the Royal Army Medical Corps for the treatment of these diseases. It is situated in the suburbs of —— amid beautiful surroundings. It consists of huts, bungalows and tentage, the streets are well paved and perfectly drained, rows of shrubs and flowering plants line these streets and everything conducive to the comfort of the inmates has been provided.

A well-equipped operating room, with special wards for surgical cases, is one of the many good features of the institution. The salvarsan room contains six tables with arm-rests, irrigator stands, etc., and the intravenous treatment is frequently given to six patients at the same time. The intramuscular injection of neosalvarsan is used in a great many more cases than the intravenous—of old salvarsan—and with most excellent results.

The number of cases of syphilis treated in this hospital since Jan 1, 1915, was 11,500. To these cases were administered over 89,000 injections of salvarsan and neo-salvarsan. The number of cases of dermatitis and jaundice developing was only 152, and the number of deaths occurring in this whole series was either 10 or 11.

As a result of the treatment in this hospital the number of troops returned to the front effective for duty was over 11,000 while the number invalided to England in the last year was only 70, which is but a fraction of the number heretofore sent home.

The French and English preparations, similar to neosalvarsan and old salvarsan, have proven fully as efficacious, and the standard treatment for syphilis in this hospital consists in the combination of the intramuscular injection of a suspension of metallic mercury, in sterile oil and water in conjunction with the intramuscular injection of neosalvarsan as well as the intravenous use of old salvarsan.

The Wassermann test is used on all cases before returning them to the front, but patients symptomatically cured, even tho exhibiting a positive Wassermann reaction, are nevertheless returned to the front because they are again effective for full military duty.

The proportion of cases of syphilis to gonorrhea is one to three. Gonorrhea here as elsewhere has proven more resistant to treatment than syphilis. The recent cases are treated with a 1 to 4000 solution of potassium permanganate used in the ordinary way as urethral irrigations. The cases of long standing are being treated with gonococcus vaccine, which is made in the hospital laboratory, and also by means of urethral bougies impregnated with any one of the various salts commonly used for the purpose.

On inquiry as to why venereal prophylaxis was not carried out in the British Army as it is in the American, I was informed that public sentiment in Great Britain had not as yet been educated up to the same point as in America, and the frank discussion of these matters was still more or less taboo. Moreover, one of the medical officers in charge made the statement that he feared that if a soldier contracting a venereal disease and not reporting for prophylactic treatment, as required in our army, would, by endeavoring to conceal his condition, so neglect himself as to become a much more difficult case to handle when concealment was no longer possible.

The other three hospitals devoted entirely to this purpose and conducted by the British Army are just as busy as No. —, so the enormous number of non-effectives caused by prevalence of venereal disease can be easily demonstrated.

Inasmuch as the startling prevalence of venereal diseases in France has been demonstrated by the experience of the armies stationed here, it is hoped that in spite of our excellent measures of prophylaxis that the A. E. F. will have sufficient hospitals in readiness for the treatment of such of our forces as become infected in spite of all of our preventive measures.

The most interesting thing observed during my several visits to British General Hospital No. —, at —— has been the research work being carried on in the hospital laboratory by Captain Pappenheim, M.R.C., U.S.A.

He has isolated a disc-like organism from a number of patients suffering from trench fever and has grown this organism on artificial media as well as on blood serum. It is found in the periosteum and around the blood vessels of the tibialis anticus muscle but not in the muscle fiber itself, and also is easily found in the stomach walls of the body louse.

EXAMINATIONS

—Physical

[A Study of About 2000 Physical Examinations of Officers and Applicants for Commissions made at the Army Medical School. By Lt. C. H. Goddard, M.C., U.S.A. *Military Surgeon*, Nov, '17. 4500 words.]

Since the latter part of April, 1917, a greater number of physical examinations of applicants for commissions have been made at the Army Medical School. Due to the number of applicants reporting it became necessary to resort to a system of "group examinations" in order to handle them as expeditiously as was required. As this system was finally developed, the applicant first reported to the "incoming clerk" (a medical officer) who entered his name, medical history, etc., on an examination form, filled out an index card, and directed him to take the papers to examiner No. 1. There were seven examiners, each one doing a designated part of the examination. The applicant visited each one in turn. The different examiners entered their findings on the form, leaving blank all items which could be answered by the words "normal" or "none," these spaces being filled in with a rubber stamp by the "outgoing clerk" while the applicant was dressing. It was found advisable to make complete

examinations in all cases, even tho deficiencies which would cause definite rejection were found.

The examination, which was careful and complete, ordinarily consumed from thirty to forty-five minutes. A single skilled examiner can make an examination of equal thoroness in considerably less time, but the group system proved much better when handling large numbers. As high as one man every three minutes has been turned out for hours at a time with very little confusion.

Of 1440 applicants for commissions examined up to Aug 1, 1917, 206, or 16.7 per cent were rejected. The chief causes for rejection were (1) under-weight, 21.8 per cent; (2) defective vision, 14 per cent; (3) nephritis (albumen and casts in the urine), 11.1 per cent. With the promulgation of the order reducing the minimum permissible height from 64 to 61 inches, and the minimum weight from 120 to 110 pounds, the number of rejections for "under-weight" and "deficient height" were materially reduced. In a second series of 1727 applicants, underweight fell to 14 per cent as a cause for rejection, while defective vision rose to first place with 23.25 per cent. The total rejections in the second group fell from 16.7 per cent to 12.5 per cent.

(The writer gives a number of tables showing in detail the causes for rejection of candidates and the defects which were waived in the cases of those passed. There were few of those found physically qualified who did not show defects of some kind.)

EXPLOSIVES

See also
Powder
Primers

[Zones of Silence in Sound Areas from Explosions. By Prof. C. E. Munroe. *Professional Memoirs,* Mar-Apr, '18. 3700 words. Illustrations.]

(The author cites a number of instances illustrating the interesting phenomenon of silent zones in the vicinity of explosions. One of the most remarkable of these examples occurred at Winchester, Ky., in the year 1884. Some 20,000 pounds of powder were exploded, thru the car in which it was placed being struck by the engine of another train. The explosion was heard 15 miles away, but spectators within 200 feet did not hear it, tho they did hear the crushing of the wooden car when struck by the engine.)

[The Principal Explosives. *Memorial Del Estado Mayor de Colombia,* Jan, '18. From *El Mundo Militar.*]

1. *Artillery Powder.*—Propelling charge consists of saltpeter, carbon, and sulphur, in the proportions 79, 18, and 3. This is the ancient black powder now used very little.

2. *Gun Cotton.*—Used chiefly as explosive charge in torpedoes; it is a high explosive.

3. *Nitroglycerine.*—Moulded with sand, sawdust, etc., to form dynamite, or else compounded with gun cotton to form explosive gelatine.

4. *Smokeless Powder.*—Universal propelling charge in all guns; used by all belligerents.

5. *Cordite.*—Used in propelling charges chiefly by the English Army and Navy for artillery and small arms.

6. *Liddite.*—A form of picric acid used by the English to charge howitzer shells.

7. *Melinite.*—The French explosive par excellence used for all purposes. Its exact composition has never been made known. The effects of this explosive are formidable.

8. *Trinitrotoluol.*—Explosive used by Germany, Russia, England and other countries chiefly to charge bombs.

9. *Tetra-nitro-analin.*—Like TNT this is a derivative of coal tar, but is still in the experimental stage.

10. *Tetranitromethylanalin.*—This is a new product developed in Germany; still in the experimental stage. It is a benzol derivative.

11. *Tetranitoanalin.*—This is composed of benzine transformed in analine after the latter has been attacked by nitric acid, in order to convert it by nitration into tetranitroanalin. This is the most terrible and most powerful explosive at present known and used in the war.

[The Energy of Explosives. By S. *Memorial de Artillería,* May, '18. 400 words.]

The energy of explosives is best expressed by comparing the quantities of heat generated at explosion by various explosives. The following table shows the relative energy of the more common explosives:

	Energy in Calories
Explosive gelatine	1,640,000
Nitro glycerine	1,580,000
Dynamite gelatine, 63 per cent	1,321,000
Balistite (Italian)	1,317,000
" (German)	1,291,000
Dynamite, 45 or 75 per cent	1,290,000
Cordite (English)	1,253,000
Nitrocellulose	1,061,000
Dynamite, 30 per cent	1,030,000
Troisdorf (German)	943,000
Powder B 4 (French)	833,000
Picric acid	800,000
English powder 55	799,000
Black powder	685,000
Fulminate of mercury	410,000

[Chemically Possible Explosives. By A. *Memorial de Artillería* from *La Nature,* Jan 26, '18. 400 words.]

An article by Mr. Stettbecher delivered before the "Societé Suisse de Chimie" on the most powerful explosives that can be manufactured.

Nitroglycerine develops only 1580 calories per kilogram, the nitric acid taking no part whatever in developing the heat. The oxidation of the carbon and hydrogen molecules which enter into the composition of nitroglycerine give only 43 per cent of the energy of combustion they give when alone.

Explosives based on liquid air give 2200 calories, as liquid oxygen combines directly with carbon and hydrogen.

The combinations of hydrocarbon with ozone

EXPLOSIVES—Continued

(ozonide)—of etelyn and benzeneitrozide—tho they do not develop more heat upon explosion, are more powerful explosives due to their rapidity of decomposition.

It is possible to conceive of even more powerful explosives, such as a trichlorate of glycerine, which would develop 3000 calories upon combustion. And lastly, a mixture of liquid hydrogen and liquid ozone, if it were made practicable, would give 4500 calories upon explosion. This is the most powerful explosive which could be obtained.

[Current Topics—The Government Dye Scheme. Anon. *Arms and Explosives*, Sept 2, '18. 200 words.]

The amalgamation of British Dyes, Ltd., with the Levinstein Company was held up partly because of the existence of an agreement of the latter with the Du Pont Co. of America. This agreement would have to be taken over by the combined concern and provides for "common property in all discoveries with full mutual disclosure of everything also considered to be of importance."

[Explosives Report for 1917. Anon. *Arms and Explosives*, Sept 2, '18. 1100 words.]

The article is a brief review of the Report of H. M. Inspectors of Explosives.

The demands on the department have been many and varied.

At the end of the year, 183 factories were carried on the books. During the war 65 new factories have been added; during the year 17. Most of the 183 factories have been inspected from two to seven times. The picric acid factories have reached a high standard.

The chemical advisers report a large number of rejections of samples, principally because of excess of moisture, due to faulty waterproofing.

Accidents during the year totaled 701 against 641 in 1916 and 485 in 1915. Of these, 405 occurred in manufacture causing 54 deaths and 330 cases of injury. Half the deaths were the result of one accident. All except two involved no more than 1 or 2 deaths each. The increase of accidents over the normal is believed very moderate.

A peculiar accident is related in which a factory completely equipped with apparatus to protect it from lightning was struck. A ton of nitro-cellulose digesting in alcohol and contained in hermetically sealed iron drums blew up. This material has been heretofore considered incapable of producing explosion, and the containers have been thought impervious to lightning.

It is probable that the laws of electrical phenomena, as at present accepted, need revision. Supplementary protection in the nature of barbed-wire fencing will perhaps be more generally adopted.

With reference to sprinkler protection, the inspectors believe that either automatic or hand-operated systems are satisfactory if kept in good condition and intelligently handled, but that a combination of the two is preferable.

Experiments have been carried out to determine the relative inflammability of the dusts of eryl, picric acid, amatol, and dinitrotoluol.

—Effect of Temperature on

[Influence of Low Temperatures on Explosives. *Mem. de Ingenieros*, Sept, '18. 255 words.]

From a series of experiments with different explosives (fulminate of mercury, picric acid, dynamite, cheddite, etc.) submitted to temperatures as low as —130 degrees Centigrade, the following conclusions have been deduced:

1. The sensibility of explosives to the action of fulminate of mercury diminishes considerably at low temperatures.

2. The velocity of propagation of the wave of explosion varies with the amount below the freezing point.

3. The force of the explosion is not diminished appreciably by hard freezing, providing the detonator preserves its strength and assures the complete explosion of the charge.

4. At the freezing point of carbonic acid the influence of the cold is much diminished.

These phenomena are attributed: first to the fact that the change in temperature causes certain physical changes in the explosive, which leave it less sensitive to the action of the explosive wave; and second to the fact that the difference in temperature between the explosive before and after the explosion is so great that a considerable part of the energy of the explosion itself is used in raising the charge to this temperature.

FEET

—Care of the

See also

TRENCH-FOOT

[Foot Strapping. By Lieut. D. J. Morton. M.R.C. With Comments by Maj. R. T. Taylor, M.R.C. *Military Surgeon*, Apr, '18. 1400 words. 2 plates.]

(A description of methods of strapping the feet with adhesive plaster for foot strains, and for cases of pronated and flattened feet.)

[Foot Care in Military Service. *Marine Corps Gazette*, Mar, '18. 5000 words.]

The maintenance of foot efficiency in the military service requires: The use of the foot in a correct manner in standing and walking; the wearing of foot coverings of correct shape and proper size; the routine care of the foot and its coverings; the immediate and careful attention to minor foot ailments.

The usefulness of the foot depends chiefly upon the possession of full flexibility and good muscular control. To these the gait owes its spring and elasticity, and in proportion as they are lost it becomes less graceful and more laborious, until the foot becomes a mere prop for supporting the body weight.

Constant standing is dangerous in that the heel bone is not placed directly under the center of the ankle, but decidedly to the outer side. This causes the ankle to roll inward and under the weight of the body as soon as the muscles relax.

While walking is a natural process and hence one acquired without special training under normal condi-

tions of life, yet this is by no means the case under the changed conditions imposed on the feet by our modern habits.

The straight position of the foot, that is, with the feet parallel, is the proper one for both standing and walking. It tends to throw the weight toward the stronger outer portion of the foot and thus to protect the arch, while toeing out allows the stress to fall on the weaker inner portion and so predisposes foot strain. In walking, insistence must also be laid on the importance of lifting forcibly on the ball of the foot. The efficiency of the foot may be measured by the strength of its thrust. In lifting on the forefoot, the vigorous walker throws the weight a little to the outer side, that is, as the step is being completed and the foot has reached the point where it is leaving the ground, it is in a position of slight in-toe. This is done n order to fully utilize the strength of all the toe muscles, since each of the smaller toes is placed a little back of the toe on its outer side.

In addition to persistent practice in walking, special exercises are of value in re-educating and strengthening those muscles particularly at fault.

1. Rotating the legs outward; stand with feet parallel and twist legs outward from hips, keeping knees straight, and the great toes as closely in contact with the ground as possible.

2. The balls of the feet are placed on the sharp edge of a depression in the ground with the toes projecting over the edge. The toes are bent downward as far as possible, if they do not bend readily, assist them with the hands until they become more flexible.

3. The foot is moved backward to a flat surface, and the toes are lifted.

4. In same position the toes are separated and then closed.

A correctly shaped and properly fitted shoe is the first essential for foot care in the military service. A correctly shaped shoe is one which adapts itself well to the heel and waist of the foot, so as to prevent the foot from slipping around in the shoe, and at the same time allows the free action of the toes. It is of particular importance that the front of the shoe be straight enough on the inner edge to allow the great toe free play and not push it towards the outer side. Sufficient length is the most important requirement to be met. For military use the shoe should be a size and a half to two sizes longer than the foot, that is about a finger's breadth longer. The width that is required varies according to the kind of socks and the number of pairs worn. Therefore, in judging the width, one must take into consideration the conditions as regards climate, season and probable trench service.

The importance of properly fitting socks needs also to be emphasized, as a too short stocking also compresses the toes and interferes with their free action, while a too long stocking wrinkles and this may give rise to a blister. As a general rule a stocking should be about two sizes larger than the shoe.

For a soldier to take proper care of his feet is a duty not less important than to see that his gun is kept in perfect condition. In attaining this condition, cleanliness is of the utmost importance. The feet should be carefully washed each day, using tepid or cold water and very little soap. Warm water and much soap tends to soften the skin; it is usually best for troops in the field to attend to this soon after arriving in camp. A canteen full of water, poured on a poncho which has been spread over a slight depression, is quite sufficient. Good results can be obtained by thoroly wiping off the feet especially between the toes, with a wet handkerchief. After washing, the feet should be rubbed thoroly to remove all loose particles of skin and then in summer well powdered, and in winter well greased. The toenails should be trimmed every ten days, being cut squarely across, as rounding the nails favors the development of in-grown nails. Thick, mishapen nails should be pared down and filed or sandpapered smooth.

Daily attention to the shoes is necesssary if one hopes to avoid the discomfort and disability due to changes in their shape and to wrinkling of the leather. If not wet or damp, they should always be cleaned at night, the inside wiped out with a cloth and the leather oiled often enough to keep pliable. When wet, they must be dried slowly, as the leather is hardened by rapid drying. A rapid and satisfactory method is to heat clean pebbles in a mess tin and then shake them around inside the shoe until it is dry, or oats may be heated and put in the shoes over night. When nearly dry the shoes should be carefully cleaned and the leather worked and oiled lightly.

Blisters are common among troops in training or among those who do not keep their feet clean, particularly if there is a tendency to sweaty feet. They are usually caused by the rubbing of an improper shoe, one that is poorly shaped, too small, or too large, or by a shoe that has not been properly cared for, in that the leather has been allowed to become wrinkled and hardened thru lack of proper attention to drying and oiling. The treatment of a blister requires first of all the removal of the cause; hence the foot must be inspected to see if proper cleanliness is being maintained, and the shoe and stocking examined for wrinkles and other defects. The blister itself should be: (a) touched with tincture of iodine, 3½ per cent; (b) pricked with a needle which has been sterilized in a match, or other flame; the fluid allowed to run out and the skin dried; (c) then covered with a piece of zinc oxide plaster or with sterile vaseline or zinc oxide ointment, and covered with a single piece of gauze bandage.

Abrasions, due to skin having been torn off from a blister, are best treated by covering them with some sterile ointment and bandaging the foot with a single layer of bandage. The foot should be powdered lightly before putting on the stocking.

The conditions in trench warfare make frost-bite something to be particularly guarded against because of the long exposure to wet and cold and inactivity. Trench foot is similar to frost-bite and is caused by long exposure to cold and wet at the same time. It is favored by anything which interferes with the free flow of blood in the feet or by anything which weakens the flow of blood generally thruout the body.

Trench foot may be avoided by proper attention to the feet and its coverings. Before going on duty the feet should be washed clean, rubbed until thoroly dry

FEET—Continued

and then well greased. Two pairs of clean, properly fitted socks should then be put on. The shoes or boots worn should be roomy and, if laced, should be laced loosely; whatever coverings are worn around the legs should also be loose.

Every effort should be made to fix trenches so that it will not be necessary to stand in water; standing in mud is not so dangerous because a little heat is retained about the feet by the mud. The flow of blood in the feet should be kept as active as possible by moving around, working the toes inside the shoes and stamping the feet. While in the trenches the shoes or boots should be removed at least once a day, and the care of the foot carried out as was done when preparing to enter the trench. When the shoes are off, the feet should be exercised vigorously. It is also necessary to be careful to protect the body generally from wet and cold as much as possible; hence returning from the trenches the feet should be again cared for as before, dry stockings and shoes put on, and the wet foot coverings properly cared for.

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[The Foot Problem. By 1st Lt. Tom S. Mebane, M.C., U.S.A. *The Military Surgeon,* Oct, '18. 2800 words.]

This article discusses the results of experiences at Camp Beauregard, where the orthopaedic surgeon is responsible for the prevention of foot trouble, the elimination of the unfit, and the rehabilitation of those with remediable foot conditions.

His duty is to see that the line officers get only foot-fit men, and also that they thoroly understand the prevention of common foot troubles. This is done principally in the form of lectures on the foot troubles which result from poorly fitting shoes and strain on the foot muscles from overexertion.

One method of inspecting for foot trouble was to have a table of such height that its top was about on a level with the shoulders of the inspecting officer, with a ramp leading to it from the floor. In this way the orthopaedic surgeon or inspecting officer could better scrutinize the action of the foot muscles with normal functioning.

The principal troubles detected were flat feet with marked abduction or eversion, rigid or spastic flat feet, bunions, amputations, partial amputations, severe derangements of the joints of the great toe, etc., etc.

Examinations of negroes disclosed 40% flaccidity. A still higher percentage appear flat-footed, but in reality this is due to the physiological construction of the foot of the negro. This is due to the large plantar fat pads and well developed foot muscles. As compared with the whites, the negro shows greater muscular development with greater tenseness on the ligaments.

To take care of orthopaedic cases, a foot camp was organized and constructed to accommodate about 300 men. These men did duty in proportion to their ability to perform it. According to the system there was always an incentive to do one's best for the privileges which were forthcoming. This had as its primary object the elimination of malingerers, upon whom fell all the onerous tasks incident to the routine.

Apart from the purely physical aspect, the mental received attention. Three types of cases are encountered: Real defects, the timid, and malignerers. By a comprehensive system of diagnosis and treatment about 70% of all cases treated were returned to full duty.

To assist the orthopaedic surgeons in their work, as well as to train men of the line in the care and prevention of foot troubles, a regular foot school was established at the orthopaedic camp. In this way a regular course was given to enlisted men which covered 15 general subjects connected with this science. Those who qualified became company and regimental non-commissioned foot officers who were charged with making inspections of feet and giving instructions for minor treatment.

FENCING

[Fencing in the Grecian Army. By Antonio Herand y Clavyo de Soria. *Revista del Ejército y Marina,* Dec, '17. 1500 words.]

(A historical article, which traces the use and development of the sword and saber, thru Grecian history, from the earliest war down to the present conflict. The tactical advantage of training in fencing is also discussed.)

—Bayonet

See also

BAYONET—INSTRUCTION AND TRAINING

FIELD ARTILLERY

See also

ARTILLERY
GREAT BRITAIN—ARMY—ORGANIZATION
(Article: "Impressions of a visit, etc.")
HORSES
MOUNTAIN ARTILLERY

Belgium

[Belgian Field Artillery During the War. By Lieut. E. Van Erde. *Revue Militaire Suisse,* June, '18. 7800 words. 8 illustrations.]

It is the object of this article to demonstrate: first, what was the state of Belgian field artillery matériel at the beginning of the war and how it was kept up, improved and powerfully augmented while the war was still going on; then how the personnel was recruited before 1914 and how it was kept up and new formations furnished during the struggle.

Matériel

Thanks to the reorganization of the army which occurred in 1913, the peace strength at the beginning of the war was six divisions of infantry and one of cavalry, totalling 13,000 rifles, 5500 sabres, 120 machine guns and 336 guns. The fact that Belgium had no secret pact with England and France is shown by the fact that on Aug 3, 1914, she had the First Division facing England, the Fourth and Fifth facing France, the Third facing the German frontier and the Sixth in reserve. If an agreement had been previously made, all would have been near to Germany ready to attack her alone if she invaded Belgium's neutrality. The only type of field piece was the Belgian 7.5 copied after Krupp but made in Belgium and modified by Belgian inventions. The piece was very strong and surpassed

so a special case holding nine 75 mm. projectiles and Two kinds of projectile were furnished, a disk time fuse shrapnel and a rather weak shell. The caisson carried 61 shells. To-day the army has plenty of small guns and also those of large caliber and long range.

The Belgian by nature likes to be self-sufficient. He builds factories from love. Many had been built when the Graville catastrophe came, but within the year new factories occupied twice the area of before and all the artillery and matériel necessary was being made. New models and types were developed. Even in England Belgians have built factories and are helping to supply the British. Each week Elizabethville, a purely Belgian city, turns out an enormous number of shells of large sizes for the British. In England the Belgians also have built factories for explosives and at Birmingham an arms factory which serves not only their own armies but also the Allies.

Personnel

In peace times nearly all of the officers of artillery came from the Military Academy, to enter which a severe selection was made by oral and written tests. Students after graduating went to the post-graduate school for two years and a half. A certain number of officers of artillery later went to the cavalry school at Ypres where the instruction in equitation rivaled that of Samur and Turin. Finally some officers attended the School of War where staff work was taken up. All officers freshened up once a year at Brasschaet at the School of Fire and every three years there were great maneuvers. It would be ten years or more before the young officer could be a captain commanding a battery, and then he would be a captain for ten years. The war materially revolutionized all of this. From the day of the declaration of war there was a dearth of officers. Reserve officers filled part of the void, then retired officers were called in. But they were not enough. A new organization was created called the "Center for the Instruction of Auxiliary Second Lieutenants of Artillery," for the more rapid production of officers. Candidates were taken from students in the Military Academy, officers of cavalry whose branch seemed not to promise the activity desired, old non-commissioned officers, engineers, and students of physics and mathematics from civil life. Even a preparatory school for the center was organized. The course was an intense one and candidates had to pass difficult examinations or be dropped. The graduates were then sent to the army as officer candidates, and after several months made auxiliary second lieutenants. The Belgians were not even content with this and created a post-graduate school, one for section chiefs and one for battery commanders. Before 1914 recruiting for non-commissioned officers and soldiers was partly voluntary and partly by selection from the annual increments of the militia. The artillerists were chosen either for their physical or their professional qualifications. The enlistment period was 26 months, devoted to careful instruction, with special schools for cannoneers, drivers, etc. All this was broken up by the invasion. Three methods were then used for recruitment: first, the artillerists from the forts of the abandoned cities were put in the field army; second, men of a certain age, married and the fathers of families; third, infantrymen useless further as infantry by reason of wounds or sickness. For the last two classes a "Center of Instruction in Artillery" was created.

Horses

Before the war the artillery horses were sufficient, of good quality and well trained. But losses in the retreat and the creation of new batteries made renewal necessary. Among others requisitioned were the pride of Antwerp—the beautiful Belgians. It was feared that they could not stand the irregular life, the noises and hardships of war, but they showed an unequaled resistance and endurance. Of course they were well cared for, the Belgian artillerist will do that before anything else. There are now divisional infirmaries for horses not capable of moving, a central infirmary collects animals which are liable to be useless for a long time. A new harness is provided with breast strap as well as collar which may be used interchangeably to aid in prevention of sore shoulders. Finally the local supply was used up, so commissions were sent to the Americas to buy animals. A central training station was established even for them. After the stabilization of battle the horses' work was lightened. The guns remain unmoved now for weeks and months. Horses are assembled in "echelons" some distance in rear of the lines and used to bring up ammunition, rations, matériel, etc.

Uniform

The fine uniform of blue short coat with red piping, breeches of the same color, red breast cord, black leggins, astrakhan cap, has given way to monotonous khaki more in keeping with the vast bare plains of Flanders. They are distinguished from the infantry by red piping as against blue. The shield bearing the regimental numbers is blue for artillery while in infantry it is red. The officer wears the same uniform that the men do, tailored of special material, the insignia gold instead of bronze or silver. He wears a brown leather belt with shoulder strap, the non-commissioned officer, the belt only.

—Ammunition—Supply Service

[Ammunition Dumps on the Battle Front. From *L'Illustration. Memorial de Caballería*, Feb '18. 2000 words.]

Formerly ammunition for the 75 mm. cannon was distributed directly from the principal supply station to the batteries, by means of the Army Corps, and Central combat trains.

Owing to the increased quantity of munitions consumed and to the replacement of draft animals by autotrucks, an intermediary step has been established between supply centers and batteries.

In order to better realize the transportation problem a knowledge of relative weights and volumes is necessary.

The 75 mm. shell weighs 7.240 kilograms; the entire projectile weighs 9.200 kilos. The explosive shell—same caliber weighs 5.300 kilograms, while the projectile weighs 7.260 kilos.

Wagons are not suitable for ammunition transport,

FIELD ARTILLERY—Continued

by far in durability the hopes of the most optimistic. weighing, when loaded, about 100 kilos has been constructed. This is the unit of transportation.

As an example of the difficulties of artillery munition supply, in the battle of the Somme 630,000 75 mm. shells were fired without interruption on a front of 20 kilometers. This is equivalent to a weight of 7000 tons and requires the services of not less than 400 ammunition carts. As ammunition is only one part of artillery supply, at that rate of consumption it would be impossible to supply the front even over the railroad lines. To meet this exigency it is necessary to construct ammunition dumps at the batteries themselves and these dumps can be maintained or increased in times of relative quiet along the front.

The problem of obtaining a good ammunition dump is a complicated one. The "flying" supply depot of each army corps should contain enough ammunition to supply units which are engaged, without the necessity of relying on any other lines of supply which may be temporarily interrupted by a retreat or otherwise. An ammunition dump should not be exposed to bombardment, as the explosion of a dump means that just so many batteries are out of action. The location of a dump should be such that it is a point of transit between heavy transportation matériel such as calculates only on rail and metaled roads; and the lighter ammunition carts, pack animals, etc. Furthermore the dump should have a complete system of interior roads, tracks and communication ways. It should also be at a short distance from the secondary line of battery positions so that animal transportation will be reduced to a minimum. The dump should be provided with a sufficient number of bombardment shelters to protect the permanent personnel and the average transient personnel and matériel. Delicate or expensive ammunition should be kept under bomb-proof shelters.

An ammunition dump ordinarily occupies 15 or 20 hectares of land. It is best to have the pile of ammunition separated by traverses which will protect one dump from an explosion in a neighboring one.

In building an ammunition dump the services of artillerymen, territorial troops, and troops on rest from the trenches will be used.

The services of construction are followed by the more arduous but systematic ones of operation. Every day during active operations a certain number of ammunition trucks, wagons, carts, and pack animals visit the ammunition dump. It is the duty of the dump personnel to keep these carriers in order, to facilitate the loading and unloading at proper places, and to keep the avenues of communication unobstructed. Ammunition trains and trucks arrive at all hours of the day and night and the personnel must see to it that the ammunition is located according to its caliber and type. Ammunition is taken out of the original cases at the dump in order to facilitate transportation to the batteries.

It is highly important that every precaution be taken to hide ammunition dumps from aerial observation.

The operation of a dump is not difficult during fair weather, but during and after heavy rain the ground around the dumps will become muddy and the constant traffic of animals and vehicles will turn the best ground into a deep mud pond, with a consequent increase in transportation difficulties. For this reason it is highly important that proper drainage facilities be provided and that all roads be at least improved.

—Defense Against Aircraft

See also

ANTI-AIRCRAFT ARTILLERY

—Fire

[Fire at Various Angles. By Maj. Germán Sanz Pelayo. *Mem. de Artillería*, Dec, '17. 11,600 words. Figures.]

(A conclusion of the series of articles beginning with the October, 1917, issue of the *Memorial de Artillería*. These articles are technical and go deeply into ballistics and the theory of artillery fire. The deductions are made from fire problems conducted by the Spanish artillery using the accepted ordnance formulas.)

[Lecture on Artillery. By Captain W. H. Addis, R.F.A. *Jour. United Service Institution of India*, Apr, '18. 4500 words. One table.]

Artillery can be divided into two classes—heavy artillery of caliber six inches or greater, and light artillery of caliber less than six inches. The primary duty of the heavy artillery is to obtain superiority over the hostile artillery. The siting of artillery behind crests and the use of gun shields make it practically impossible for light artillery to perform this task. Counter-battery work of the heavy artillery is greatly facilitated by the co-operation of airplanes. The remainder of the artillery work is mainly performed by the light artillery. The 18-pounder (3-inch) Q. F. field gun has proved itself the best shrapnel gun of the war, and can fire 20 aimed rounds per minute for a considerable time with a trained detachment. The average time from "action to first gun" for the field artillery is about 30 seconds, but the record is 8 seconds. The 4.5-inch howitzer can fire 8 to 10 aimed rounds per minute.

In co-operating with infantry, a careful description of the target to be engaged is necessary. On squared maps this is easy, tho constant practice should be had. Some people have difficulty in locating their own position on a map, not to mention an object several hundred yards away. The artillery methods of pointing out objectives should be known to all infontry officers.

The infantry should know the difficulties of close shooting in the field by artillery, and the precautions taken to avoid hitting their own infantry, so that the infantry may be charitable if this should happen. Trench warfare frequently necessitates bombarding an objective close to the line of our own trenches, possibly requiring the clearing of the trenches. Accuracy of fire is therefore of great importance to all concerned.

The first step in accuracy is the calibration of the guns by actual firing at a range of about 3000 yards. The necessary correction in elevation is noted for each gun. Calibration need not be repeated unless the guns are subsequently subjected to considerable wear. Temperature and wind may affect the range by approximately 100 yards at 3000 yards range, and these factors must be constantly watched and taken into account.

In addition to the variables, the artillery has to contend with the errors of the gun and fuse. The projectiles may fall as much as 62 yards beyond or short of the true range at 3000 yards. The fuse error is equal to 81 yards at 2000 yards. Including gun and fuse error, the infantry must be 165 yards behind the mean point of impact to be perfectly safe. This maximum error occurs very infrequently, of course.

If it is desired to bombard a point very close to the trenches, three courses may be pursued; (a) the trench may be evacuated during the bombardment; (b) the mean point of impact may be established so that the trenches will be outside the 100 per cent zone error; or (c) the guns may fire obliquely to the line of trenches so that the range error is nearly parallel to the trench. The latter is by far the preferable method.

In co-operating with infantry, observation officers are sent forward from the artillery to a post on high ground overlooking the enemy's position when such points exist, otherwise to the infantry positions. Complete arrangements for communication must be made. During an advance, a liaison officer is provided by the artillery as a means of communication between each infantry brigadier and the artillery brigadier of the division.

There must be complete understanding and interchange of information between the artillery observation officers and the infantry commanders in order that there may be prompt and full co-operation under the stress of action.

A battery in position proceeds to "register" such points in its field of fire as are necessary for effective fire. The process of registration is that of finding by actual firing the azimuth, elevation and fuse to the prominent points in the field of fire. This data is recorded in the gun register.

Wire cutting is most effectively carried out by the 18-pounder Q. F. gun using shrapnel, tho the 60-pounder shrapnel is also used. High explosive shell is useful in conjunction with shrapnel if the wire is supported on iron pickets. High explosive shell has not the cutting effect of shrapnel and the craters of heavy shell are in themselves a serious obstacle to infantry. The most effective range for wire cutting is from 1800 to 2500 yards, and 3500 yards is the maximum beyond which the shrapnel bullets will not cut the wire.

It is best to cut wire with one gun, as control is easier. It may be advisable to commence with all guns and use the one that settles down to steady shooting first. Frontal fire should be used when possible. If oblique or enfilade fire must be used, double observation is advisable. The ideal burst is four feet up and actually in the wire. A round 5 yards short may be quite ineffective. A clear line is first cut thru and then gradually widened.

The artillery has two general duties: bombardment and covering fire for assault. Definite tasks, such as cutting wire, searching communication trenches and approaches, and intense bombardment at stated times, are assigned.

During the assault the rôle of field guns is to form barrage for isolating the attack, to deal with counter attacks, and to bombard the trenches up to and immediately before the assault. Special attention is paid to machine gun emplacements, strong points, etc. The infantry can assist by observing and reporting the effect of the artillery fire on these latter objectives.

When the assault has been launched, the artillery must keep down the fire of hostile artillery, keep enemy communications and back areas under fire to prevent bringing up reserves, and support the infantry by destroying such enemy works as impede their advance. The latter is difficult mainly because of the difficulty of transmitting information under the conditions of an assault. If the enemy's artillery is not silenced, transmission of information will be difficult if not impossible, and always uncertain.

There must be complete understanding by the infantry of the necessity of keeping the artillery fully informed. If a working party is sent out, word should be sent to the artillery, otherwise they may be fired on. The most (apparently) trifling happenings are worth reporting.

[The Effect of Artillery Fire. *Norsk Artilleri-Tidsskrift.* German version by General Rohne from *Artilleritische Monatshefte.* July-Oct, '17. 500 words.]

In spite of the increased artillery, its effect against troops in comparison with the ammunition used is far smaller than in all previous wars. The French artillery in the battle at St. Privat on the 18th of August, 1870, were using about 100 kg. of projectiles for each man put out of action. In the Russo-Japanese war the figures are 40 shots or about 290 kg. In the present war the figures are still higher. The losses of each battle are, however, not known: in the battle of Champagne in the fall of 1915, the French artillery fired over a million shots. If 40 shots had been sufficient to put one man out of action, the German losses owing to the artillery fire alone would have been 250,000 men. But the losses were not near so large. As two-fifths of all ordnance belongs to the heavy artillery, the average weight of the projectiles may be put at at least 15 kg, thus 600 kg. would be necessary to put a man out of action, which is six times more than during the war of 1870-71.

It would, however, be wholly erroneous to draw the conclusion that the effect of the artillery is small. The object of the artillery is less to cause the greatest possible losses with the least possible use of ammunitions than to prepare the way for the infantry, either by disturbing hostile fire or by destroying obstacles and covers. More than ever the infantry has to fall back on the support of the artillery. The same causes which diminish the effect of the artillery fire also diminish the effect of the infantry fire in a still higher degree on account of the flat trajectory of the rifle bullet. There are still few data available regarding the distribution of losses between infantry and artillery fire, but according to information already received it seems that the share of the artillery has become greater than in any previous war, the war of the Crimea possibly excepted. The Bohemian campaign in 1866 is of special interest in this respect, as very accurate statistics are available; of each 100 put out of action 90 were put out thru rifle and only three thru artillery fire, giving a ratio of 30:1 on the Austrian side: on

FIELD ARTILLERY—Continued

the Prussian side the ratio was 5:1. In 1870-71 the ratio on the French side was 2.8:1; in the Russo-Japanese war, 5:1.

The ratios for the present war are, according to the French surgeon Hartmann, 0.53:1 for cases treated by him: according to another French army corps surgeon the ratio would be 0.2:1: the information from an English hospital, published in *Army & Navy Journal*, give 1.3:1. Rohne remarks that this result so favorable for the artillery may be ascribed to its tremendous increase.

—Fire—Against Aircraft

[Artillery Fire Against Aerial Targets. By Sallustio Regii, Major of Artillery. *Rivista di Artiglieria e Genio*, Oct-Nov, '17. 10,000 words.]

Aerial targets are of three classes—dirigibles, hydroplanes and airplanes. Of these the last named are the most important by reason of their number, and also the most difficult by reason of their speed.

The importance of fire against these targets has become more and more clearly recognized since the beginning of this war. Special matériel for this use is never sufficient, and guns on ordinary mountings of all kinds are continually called upon.

This kind of fire presents unusual difficulties, due to the speed of the target and the necessity of using time fuses. The method adopted must necessarily be a compromise between two conflicting requirements, accuracy of preparation and rapidity of execution.

In ordinary fire against terrestrial targets the angle of site is small, and the principle of the rigidity of the trajectory generally applies; that is, the readings of the rangefinder, quadrant and fuze-setter agree. With a large angle of site, as is always the case for aerial targets, this condition does not obtain. The interrelations of the various elements of the firing data are no longer constant; for example, with the same actual range, the sight elevation will vary as a function of the angle of site.

Ordinary range tables, then, are useless, since they are calculated on the basis of horizontal range. It is necessary to have an entirely new system of tables, calculated by selecting some one element of the firing data, and arranging the other elements according to the increasing values of this. If, for example, the angle of site is taken as the argument, a separate table is required for say every 100 mils change in site, from the horizontal up to the maximum permitted by the carriage, which is generally about 1200 mils. Or, if the tables are based upon the speed of the target, which is more convenient in practice, tables should be computed for the varying angular heights, for every hundred mils; the argument of entrance would be the angle of site.

In this latter system, the distance travelled in a given brief time being determined, each successive angular altitude determines a sight elevation and a fuze setting which will keep the mean trajectory upon the target.

Thus a distinct advantage is gained by discarding range as the prime element, whether it be measured on the horizontal or on the line of site. The angle of site also varies from moment to moment, but it is more readily and more accurately measured at the battery.

But firing data as given by the range tables are not sufficient. The target is constantly and rapidly changing position in all three dimensions, during the time between command and shot, and during the time of flight. Hence we must correct the range table data in such a manner as to follow the target in its motion.

The problems to be solved, then, are: (1) determination of firing data for a particular position of the target; (2) estimation or measurement of the elements of correction necessary to allow for the travel of the target; (3) development of a system of conduct of fire which shall permit adjustment of fire, or eliminate the necessity for it, and a determination of the practical rules for easy and rapid application of the system.

PREPARED FIRE AGAINST AIRCRAFT

1. *The Ballistic Problem*

Given a target moving in space, if the laws of its motion can be determined, we may determine the point upon which the gun must be laid, and the proper moment for firing, so as to bring burst and target together.

Direct Laying

The position of the target in space is determined at any given moment by three co-ordinates: angle of site, range and direction. Suppose that we have range tables so constructed as to give us, with site and range as the arguments of entrance, the necessary sight elevation, fuze setting, and deflection. If we then lay directly upon a stationary target, the shell should burst in it. But the target is moving. The problem, then, may be defined as follows:

To lay the gun upon point C, and fire at such a moment that the target and burst will meet at D. The relative position of the two points is determined by the condition, that the target must pass from C to D in the time of flight.

Indirect Laying

The problem is the same, but we now take deflection from some point other than the target, and deal with quadrant instead of sight elevation. This simplifies matters, in that we may use range table data for the point D, and need not consider C. There is, however, the disadvantage that the gun does not constantly follow the target; hence many batteries use quadrant elevation, but sight direction.

2. *Movement of Target; Assumptions*

A bombing airplane must fly as straight and as uniformly as possible; a reconnoitering plane may vary only within restricted limits. When threatened with a fire attack, the plane maneuvers, which increases the difficulty of adjusting fire; but generally when an airplane has a specific task its freedom of maneuver is limited.

The problem is complex—to cause a projectile in flight to meet a small and speedy target, whose laws of motion are not accurately known. The system must be one of approximation.

If we consider only the time for preparation to fire, and the time of flight, twenty or thirty seconds perhaps,

we may assume that the motion of the target is rectilinear and uniform.

3. *Continuous and Intermittent Fire*

Firing data may be worked out directly, for the probable position of the target at the instant of burst, or indirectly, by applying corrections to the data for the position of the target at or before discharge. In the first case the fire must be intermittent, each shot or group of shots being preceded by a period of preparation. In the second, the fire may be continuous, using the methods of ordinary fire and modifying the corrections as required.

To determine the probable position of the target at the instant of burst, it is necessary to resolve the motion of the target into components. This may be done either along the line of site (change in range), and in the plane normal to it; or in the horizontal and vertical planes.

The former method is convenient for guns using direct laying. The elements may be determined by direct measurement of the range and angle of site. The latter method eliminates the use of corrections to angle of site and deflection; it is most suitable for indirect laying.

The best method of predicting the position of the target is to construct a diagram of its course. If we plot time as abscissa and range or any other element as ordinate, we get a curve from which, by extrapolation, we may predict position. The predicted position will determine one value of the element which has been selected as argument of entrance to the range tables.

The diagram, evidently, should be plotted with elements that may be accurately measured; and it must be so planned that it may be quickly and accurately plotted. This suggests use of site instead of range, and of a rectilinear instead of a curvilinear diagram. This may be accomplished by using a special cross-section paper, in which the intervals between the horizontal lines vary according to the scale of cotangents.

For continuous fire, we determine, not firing data for a predicted point, but corrections to the firing data for an actual point. The diagram may be used for this purpose also, or the corrections may be determined by other means.

For example, if we have ranges taken continuously, the range correction is the change of range during a period of time equal to the sum of the time of preparation and the time of flight. It is not difficult to design instruments which will give these corrections automatically, for all elements of the firing data, including fuze setting.

4. *Determination of Firing Time*

For intermittent fire this is of prime importance, since an error of two or three seconds may cause an error of several hundred meters. The gun may be fired at the instant the target passes the point C (*supra*), or at the predicted time. Or, better, the time of preparation (which should be constant) having been determined, we may consider the actual interval between shots; the guns may then be fired when ready, without command.

In continuous fire the guns fire individually when ready; time of preparation is of less importance. But in any case it is desirable to reduce it to a minimum. The fire is always based upon prediction, and the shorter the period of prediction the greater the accuracy. The ideal would be to make the interval equal to the time of flight alone, admitting no time of preparation beyond this; since the fuze setting is the slowest operation, this would require the development of a system based upon fuze setting, so that a number of rounds could be prepared beforehand.

DETERMINATION OF DEFLECTION AND SITE CORRECTIONS

1. *Correction of Deflection*

This is equal to the angular travel of the target in the horizontal plane during the time of flight, which may be determined in various ways. One convenient method is direct measurement with a goniometer; it is best to take the readings every ten seconds, and to take the travel for the time of flight from suitable tables or graphic charts.

But this method is not very accurate a better system depends upon the angle made by the course of the target with the plane of direction, which may be estimated or measured with sufficient accuracy in several ways. Knowing the speed of the target, the range, and this angle, the correction may be calculated by a simple formula, or taken from a chart.

Still another plan is to take this correction from a diagram of the path of the target, plotted as described above. A suitable diagram would be one showing the curve of azimuths of the target every ten seconds.

In final determination of this correction, allowance must be made for cross wind.

2. *Correction of Site*

This correction may be applied practically in any way rendered convenient by the laying instruments used. It is equal to the angular travel of the target in the vertical plane during the time of flight.

The site may be measured directly every ten seconds, and the correction determined by suitable tables or graphic charts. As in the case of deflection corrections, other more accurate methods may readily be devised. When the correction is made by simply measuring the site, it is necessary to remember that if the linear velocity is constant (as assumed) the angular velocity will be variable, the acceleration being positive when the target is approaching and negative when it is receding. Ordinarily, an arbitrary correction of five or ten mils will be near enough for this.

[Fire of Artillery Against Aircraft. By Sallustio Regii, Major of Artillery. *Rivista di Artiglieria e Genio,* Dec, '17. 10,000 words.]

ADJUSTMENT OF FIRE

We have seen how firing data may be obtained for separate shots; but adjustment is always necessary after the first shot. We must inquire whether this is possible in fire against aircraft, and if so how it may be done.

Three separate corrections are necessary—in direction, height of burst, and range. These should be made

FIELD ARTILLERY—Continued

by different cannoneers, and if possible with appliances other than those used for the initial data.

Adjustment, as well as preparation of firing data, must be made on the assumption that the target is following a certain definite course. Therefore, corrections should be made only if this is observed to be the case, unless the necessity of the correction is manifest in spite of a slight change of course.

The effect of corrections can not be seen until after a period of time at least as great as the time of flight for the given range; hence deviations observed in the meantime should be disregarded.

1. *Adjustment in Direction*

Observed errors are due to peculiarities of the gun, atmospheric conditions, wind, and errors in determination of the speed, height and range of the target. They should be measured directly, in mils, by means of a suitably graduated telescope. In case of time shrapnel fire, the bursts should be slightly (5 or 10 mils for a 75 mm. battery) ahead of the target, to allow for travel during the time of flight. When the firing is with several pieces, the correction should be made for the estimated mean point of burst.

2. *Adjustment in Height of Burst*

The height of burst is measured from the line of sight. Its accurate adjustment is less important than that of the direction, since fire against an aerial target is always echeloned in range, and hence in height of burst.

Corrections should be made by varying, not the corrector, as with a ground target, but the site or range setting.

The proper height of burst depends upon the projectile and the range. With time shell, it should be zero or one mil. With shrapnel, it is greatest at long ranges, and diminishes as the range decreases or the angle of site increases.

3. *Adjustment in Range*

Axial observation for range is possible only in the exceptional cases where the bursts are on the line gun-target. Flank or forward observation is reliable only if the fire is well adjusted in direction and height of burst. Special care is necessary in observation if several batteries are firing at the same time; each battery may be assigned a certain sector of fire, or a special projectile, or a projectile giving a distinctive color of smoke.

The duration of fire against an aerial target is generally very short. For this reason, some systems exclude any idea of correction in range. But it is impossible to make the initial data accurate enough, especially in view of unforeseen variations in the speed and course of the target; and either the volume of fire must be made so great as to compensate for all inaccuracies, or a system of correction must be developed.

If the first plan be adopted, a scheme of echeloned elevations, fuze settings and deflections must be prepared, in such a manner that one-half the dispersion in each direction will be greater than the corresponding components of the probable change in position of the target. This will generally require a battery of a large number of pieces; it might be used, for example, with the air defense batteries of battleships, which consist of from 8 to 12 guns.

The system of correction by observation is, ballistically speaking, much more logical. Evidently, however, it involves great difficulties, considering the necessary rapidity of fire, the short time available, the slowness of communication between gun and observer, etc.

These difficulties seem almost insurmountable, if the fire is based, as with ground targets, upon ranges. This is by no means a constant element, but varies greatly in a short time. Certain other elements of motion vary much less; *e.g.*, altitude, speed, etc.

Considering altitude alone, it is evident that if this be determined, and remain constant, a range finder is unnecessary. It is sufficient to measure the angle of site, and deduce the range. If the altitude varies, the variations can not be great in the short time considered, and it should be possible to determine a proper correction.

If the altitude (H) is assumed to remain constant during the fire, the range (D) is equal to H/sin e, in which e is the angle of site.

If D, D′, D″ . . . are successive measured ranges, and D_a, D_a', D_a'' . . . the corresponding adjusted ranges, then, approximately,

$$\frac{D}{D_a} = \frac{D'}{D_a'} = \frac{D''}{D_a''} \ldots = m$$

If we now give to H the fictitious value $H_a = mH$, the ranges read on the instrument used in the conduct of fire will be the adjusted ranges. Adjustment, then, consists in dtermining the proper value to be assigned to H_a, which will generally not be equal to H.

In practice, the value of H will not be constant; but this is immaterial, since with a suitable instrument it is possible to measure the height continuously. The mean rate of change may be determined, and set on a suitable scale on the instrument used in conducting the fire. The instrument will then read the true altitude, and corrections may be made on this scale.

Adjustment should be continuous, and based upon observation of a group or series of shots.

The system of basing adjustment upon altitude is very convenient in directing the fire of a group of batteries. The altitude being independent of range, batteries not firing may correct their initial data by observation of the fire of others, so as to secure effect more quickly when their turn comes. This is of special importance if batteries are not provided with special instruments for measuring altitude.

4. *Conduct of Fire*

The method must be to create a zone of fire, large enough in all three dimensions to include the probable position of the target. While adjustment need not be omitted, it must be rapid and only approximate. As has been noted above, the fire may be either intermittent or continuous.

In the former case, there will be no adjustment in range, but possibly a rough adjustment in height and

direction. The fire will consist of rapid bursts, broken by pauses for determining new data. These pauses are an absolute waste of time and should be made as short as possible.

Considering the shortness of the time available for fire against an air target, it is evidently desirable to make the fire continuous; and the system based upon altitude of target is the simplest. There is little time for adjustment, and it is best to echelon the fire. The depth of the zone may conveniently be made 500 or 600 meters, and the increments 100 or 150. The actual changes in sight setting depend, of course, upon the desired range increment and upon the movement of the target. Approximate rules for sight changes have been worked out.

The method of determining the short limit of range to be used will differ according to the instruments available. The instrument should be so constructed that corrections may be set off on it, and the corrected firing data read directly. Extreme accuracy is not necessary, since a deep zone will be covered in any event.

5. *Range Finders*

A range finder is necessary to get any effect, but its method of use differs according to the system of fire. In intermittent fire, the data are based directly upon its readings; in continuous fire, it is used only to check from time to time the altitude of the target, which is used as a basis for determining data.

Self-contained range finders are very satisfactory, and are indispensable to mobile batteries. For a fixed battery, a range finding system of two stations may be used; or better, three stations, disposed in an equilateral triangle with the battery at the center:

(Numerous mathematical demonstrations are given in an appendix.)

See also
ANTI-AIRCRAFT ARTILLERY

—Fire Control

[Angle Fire at Various Altitudes. Maj. German Sanz Pelayo. *Memorial de Artilleria*, Nov, '17. 30,000 words. Tables, formulae.]

(A highly technical article on artillery firing deduced from the field firing of Spanish batteries and applied to the general cases. It presents a purely theoretical, but highly comprehensive, treatment of trajectories, angles of departure, points of burst, points of impact, etc. The article is not such as to permit of satisfactory condensation.)

[The Fire of Medium and Heavy Calibers in the Mountains. By Mauro Picone, Capt. of Artillery. *Rivista di Artiglieria e Genio*, Oct-Nov, '17. 2000 words.]

(Conclusion)

V.—Problems of Fire

By the methods explained in the previous chapters, the following problems are mathematically discussed:

Problem I. Given the co-ordinates of a target, and the angle of elevation, to determine the proper initial velocity, the terminal velocity, the angle of fall and the time of flight.

Problem II. Given the co-ordinates of a target and the initial velocity, to determine the elevation, terminal velocity, angle of fall and time of flight.

Problem III. Given the initial velocity, elevation and angle of site, to determine range, angle of fall, time of flight and terminal velocity.

VI.—Determination of Data for the Correction of Fire

In conducting a bombardment, it is desirable to know how the elevation should be varied, the charge remaining constant, in order to place the projectile at any point on the ground, within a sphere whose center is at the target and whose radius generally does not exceed 200 meters.

This problem may be solved with sufficient accuracy by the methods explained above. The plane of fire cuts the imaginary sphere in a great circle; the co-ordinates of the points where this circle enters the ground may be determined. The elevation for each of these points may be calculated as above; then by causing the elevation to vary between these limits the projectile may be placed at any desired point. The calculations may be made very quickly; so also those to determine the terminal velocity and angle of fall corresponding to any given elevation.

VII.—Calculation of the 50 Per Cent Zone for any Given Plane of Site

It is evidently desirable, for fire in a mountainous country, to know the 50 per cent zone for any given angle of site, and also for any given slope of the ground at the target. Methods are given for calculating these from the known zones on a horizontal plane.

[Command of a Firing Battery from a Distance. By Jésus Badillo. *Memorial de Artilleria*, Jan. '18. 2000 words. Tables, figures.]

In general, the tendency during the present war has been to adopt the broadest front possible for an artillery battery, from which the fire can be directed on any one point. This has necessitated the separation of the battery commander from his guns.

In order to maintain the liaison between batteries and their commanders each battery has been equipped with two complete telephone stations. In this way the maximum efficiency and rapidity in fire correction and control has been assured.

The placing of a battery commander at some distance from his battery makes the range correction more difficult, and increases the difficulty of determining the height of burst in time fire. (To facilitate the determination of height of fire burst the author has constructed a double entry table which is entered with the range on the vertical columns and with the distance of observing station to the battery in the horizontal lines. These co-ordinates locate the typical height of burst in mils.)

The range correction is simply a correction for parallax due to the B.C. observing station being to the right or left of the firing battery. (The author has also prepared a parallax table, which is appended to the article.

FIELD ARTILLERY—Continued

Examples of the use of both tables are given.)

[Scale of Convergence for Spanish Field Batteries. Maj. G. S. Pelayo. *Memorial de Artillería*, Mar, '18. 4000 words; Figures.]

(The original should be read as this article is a theoretical determination of the scale of convergence and consequently does not admit of condensation.

The object of determining the scale of convergence is that the beaten zone of a battery may be properly located on a target and evenly distributed over the target.

The problem is solved for various relative locations of battery, target, and aiming point.)

—Fire Control—Aeronautic

See also

AERONAUTICS (Article: "Artillery and Aviation.")
CAMOUFLAGE (Article: "Artillery Camouflage on the Western Front")

[Co-operation Between Balloons and Artillery. By Maj. D. R. Hannay, R.F.C. *Aerial Age Weekly*, Nov 5 and 12, '17. 1685 words. Illustrated.]

The balloon service of the Royal Flying Corps is divided into wings, companies, and sections. A section consists of four officers and 90 men and works one balloon. A company consists of two sections. A wing consists of all the companies in any one army. The balloon now in use in the field has a cubic capacity of 950 cubic meters and is capable of lifting two observers to a height of 4000 feet. The majority of balloons in France are stationary, at an average distance of about 6000 yards behind the line. As regards observation of fire, the work of the balloon observer is chiefly with the heavier pieces of artillery, such as the 6-inch howitzers and the 4.7-inch guns, 8-inch howitzers and the 60-pounder guns, 9.2-inch howitzers and the 6-inch guns, 12-inch howitzers, 15-inch howitzers.

The balloon section is connected by telephone to all the batteries with which it is likely to work. An advantage which a balloon has over an airplane, and one that compensates for a great many of the disadvantages, is that the observer in the basket can talk direct by telephone to the battery commander on the ground, and does not have to confine himself to a limited code as used on the wireless. When the balloon is in the air, it is connected by a telephone cable to the winch, which is, in turn, connected by aerial line to the camp exchange, and tapped in on this line is the chart room of this section, where all the map work and the arranging of shoots with batteries are done. The work chiefly allotted to the balloon consists of:

1. Destruction of villages;
2. Destruction of strong points behind the line;
3. Registering on cross roads;
4. Registering on exits from villages, woods and ravines;
5. Counter-battery work

Artillery officers will fully realize that it is not advisable to give observations as regards range until the battery drops a shell fairly close to the balloon-target line. Then, when the observer is able to check the range, the battery commander will register by the bracket system, always remembering that to keep his shells falling on the line balloon-target, it will be necessary for him to give deflection for each increase or decrease in the range ordered on the guns. The chief object of the observer is to describe to the battery commander briefly, but clearly, the position of each shot. When the balloon goes up and the observer is ready, and can clearly see the target, he sends the following information thru the chart room to the battery:

1. Position of balloon.
2. Height of balloon in feet.
3. Strength and direction of wind.
4. When he is ready to observe.

The battery will then send to the balloon:

1. Time of flight of shell.
2. Nature of projectile.
3. When they are ready to fire.

When both observer and battery report they are ready, the battery will send, "Stand by," and the observer will then give, "Ready." As soon as "Ready" is received by the battery, the guns will be fired at once and "Gun fired" will be sent to the balloon. When the battery sends "Gun fired," the chart room officer sets his stop watch going and says, "Gun fired," to the observer, then, at the correct time: "10 seconds to burst"; "5 seconds to burst;" "4"; "3"; "2"; "1"; "Burst." This relieves the observer in the balloon of watching with his glasses the whole time. When he hears "10 seconds" he gets ready, and at "5" puts them up. First impressions are always best in balloon observations. Let us say the first observation is:

"First shot—30 minutes left."

"Short" or "over" is not given, as, the shot being wide of the target, the observer cannot say for certain. "Unobserved" should always be sent if the actual burst is not seen.

Batteries must expect to get a number of unobserved shots, and must not get impatient with an observer who sends down several of them, as it is just as likely to be the fault of the battery as that of the observer. So the shoot proceeds until the target is registered, when registration is taking place, or demolished if the battery is shooting for effect. The observer sees the flashes of a hostile battery. As quickly and accurately as possible he notes their map position. This reading is sent down to the chart room officer, who will check it with the records showing the position of all hostile batteries which had been previously reported. When reporting hostile flashes the observer will endeavor to locate the ground in our lines which is being shelled.

The balloon section should co-operate as much as possible with the airplane squadron attached to the corps for artillery observation, and, whenever possible, the officer commanding the corps squadron and balloon section should meet the G. O. C. Corps Artillery the previous evening to arrange the work of the succeeding day. Balloon observers frequently visit the batteries with which they work, and it is a strict order that, if any-

thing goes wrong during a shoot, or if the shoot is unsuccessful in any way, the observer must, as soon as he comes down, visit the battery to find out what has happened at the battery end and work things out with the battery commander so that no mistakes will happen the next time. Dead ground is also a handicap in balloon observation. All balloon sections have maps prepared with all dead ground at the normal range and normal height shaded in, so batteries can always be previously informed if any particular target is invisible to the observer. To get the best results artillery officers must appreciate both a balloon's powers and its limitations, and then by thoro co-operation much excellent work can be done.

[Artillery and Aviation. Carlos Martínez de Campos. *Memorial de Artillería,* Apr, '18. 16,000 words. Maps and figures.]

Fire Correction

In the opening battles of the war the Allies found that they would be forced to arrange for aerial observation of artillery fire on the hidden German targets. In the battles of Ypres and Furnes in the early part of the war, the few Belgian planes were charged with all observation duty, and with their aid the defense was able to cover itself with glory.

The proceeding in the present system of fire correction and observation is not known, but it may be said that the Allies have reached the peak of perfection in this particular line of development. The best system of communication between airplanes and batteries is by wireless telegraphy. In case this means is used, the airplane observer practically becomes the battery commander of the battery whose fire he is directing. Besides the wireless, Very pistols, Klaxon horns, etc., are used to communicate between airplanes and the ground.

The importance of airplane artillery control is so great that in many cases a battle will be held up until the artillery observers are able to get into position. Artillery fire is indirectly controlled from the air by using the airplane photographs in locating and plotting targets and gun positions.

The photographs are taken at any altitude and then reduced to a common scale. The cameras for this work are of many types. The Doubet—invented by the Italian engineer, is a camera which is capable of photographing, in a single flight, a strip 600 meters wide and 250 kms. long. For this particular instrument, the airplane should preserve an average altitude of 1000 meters.

Direct Relation Between Airplanes and Batteries

(This section of the article should be read in the original, as the explanations are made with reference to figures and drawings which cannot be reproduced. In general, the discussion covered the following points:

1. Tactical advantages of aerial observation.
2. Comments on the preparation of fire.
3. Present instructions.
4. Determination of range.
5. Correction of range.
6. Same for deflection.
7. Special cases.
8. Practicability of fire observation from airplanes; length of time this process requires for completion, and general summary.)

—Heavy

[Under the Domination of the Heavy Artillery. *Schweiz. Zeitschrift f. Art. u. Genie,* Apr, '18. 975 words]

Almost every campaign has its distinctive features. In 1866 the Prussian infantry and the Austrian artillery gave the character to the war; in 1870 the German field artillery, in 1877 the Turkish field fortifications. The present war is under the domination of the heavy artillery.

It is part of the service of the late German Chief of the General Staff Schlieffen that he most emphatically insisted on the introduction of heavy artillery in field armies. This idea was laughed at by many. In time of peace mobility is striven for rather than effect. In time of yar effect gains the upper hand. The artillery must surpass the enemy in caliber and in weight of projectile. The heavy artillery comes into its own. Mobility is, indeed, acquired by the use of mechanical traction.

France suffered from a lack of heavy artillery at the beginning of the war, and the defect was remedied only by the ability of the English to supply heavy guns. There was nothing to compete with the German mortar and howitzer batteries of calibers 15, 21, and 28 cm., or the Krupp 42 cm. guns, or the Austrian motor batteries of 30 and 38 cm. Only the protection of the position war enabled the French to remedy this defect.

These large calibers have their disadvantages. The ordinary field gun can fire 4000 shots before the rifle is worn out, whereas the life of the 21 cm. gun is 400, and that of the 30 cm. gun is 150 shots. These are average values, individual guns varying 50 per cent either way. Obviously such guns cannot engage in rapid fire. Furthermore, the greater the caliber, the greater the difficulties of transport. Heavy artillery needs practicable roads. Often, therefore as at the Dunajec, in Poland, in Serbia, and in Rumania, considerable time is lost before it can be utilized effectively. Frequently hard preliminary fighting must precede the attainment of positions suitable to the objective, as was true to a certain extent at Verdun, in the Somme battle, and in Flanders.

—Heavy—Instruction and Training

United States

[Coast Artillery Training Camp. *Army & Navy Jour.,* Apr 27, '18. 325 words]

The Coast Artillery Corps in aid of its work in supplying the army with heavy artillerymen is organizing the new training school which has been designated Camp Eustis, near Fort Monroe, Va. This is a two-brigade camp and will be equipped in all respects in the same manner as the U. S. Artillery camps in France. The guns installed are the same in caliber and design and are mounted on the same type carriage as the artillerymen under training are expected to control when it comes to actual fighting on the line. The commanding officer, Col. Frank K. Fergusson, has recently re-

FIELD ARTILLERY—Continued

turned from service in the U. S. Artillery School in France and has under him officers trained in the same school. In addition to these several officers from the Allied armies are attached to the instructor's staff. The officers and men will receive the same course as those who are detailed to the schools of instruction in France and the graduates will be ready to go to the front for hardening with the men wh have been put thru the schools behind the lines.

Near Camp Eustis is Langley Field, from which observers will come in the airplanes to study the fire from the guns and how to spot and report the shots as they fall upon the range. Close by the Signal Corps will establish a balloon station from which observers will make similar studies. They will also practice the art of bomb-dropping on the range attached to the camp. The new camp grounds proper include 300 acres. The cantonments will accommodate two full brigades. The ample ranges give a practice ground of something more than 20,000 yards.

The camp is named after Col. Abram Eustis, of the 4th Artillery, U.S.A., who was the first commander in this country of a camp for the instruction of men and officers in the use of heavy artillery. That camp was established in April, 1824.

—Instruction and Training

Great Britain

See also

INFANTRY—INSTRUCTION AND TRAINING—GREAT BRITAIN (Article: "Tests of Military Efficiency in England")

Peru

[Preparation of Artillery for Battle. By Maj. Ernesto Romero. *Boletín del Ministerio de Guerra y Marina* (Peru), Feb, '18. 2000 words.]

This is a general treatise on artillery training methods as applied to Peru. The author takes up marches, camping and bivouacs, study of positions, and battery emplacements, firing, changes of position and supply.

The chief object of all exercises given as suitable training, is war preparation of group artillery commanders and all persons under the orders of the group commander.

The author states that exercises of this kind should be carried out with the objects of increasing the tactical knowledge of officers; of giving officers and non-commissioned officers opportunities to rise and develop their initiative and ability to make quick decisions by using batteries on a suitable terrain; of accustoming officers to formulate simple orders and to pick out clearly the faults in their subordinates; and finally of giving all men confidence in themselves and their chiefs by making each one master of his war time task.

[Preparation of Artillery for Battle. By Major Ernesto Romero. *Boletín del Ministerio de Guerra y Marina* (Peru), Mar, '18. 4000 words.]

A schedule of drills and exercises for artillery as follows:

Elementary exercises conducted in the batteries and exercises for non-commissioned officers, all without matériel, and finally drill with matériel. The schedule is arranged in six series as follows:

1. Drills in billeting and bivouacing comprising the billeting of an organization and stabling of a part or the whole of its stock, and the bivouacing of an organization and picketing of animals.
2. Problems for scouts; in orientation; liaison with the infantry, including the service of security and information for artillery, artillery reconnaissance, and the arrangement of itineraries. For orientation officers, the drills comprise position reconnaissance, fire control, and location of targets. For liaison officers, instruction is given in the organization and functioning of this service between infantry and its supporting artillery.
3. Study of battery positions and emplacements, their construction and their proper location on the terrain according to the situation.
4. The reconnaissance and occupation of positions. These drills take place first in the drill field and later on broken ground. The batteries are assumed to be under varied orders—that is they may be supporting an artillery force, supporting an infantry attack, an advance or rear guard, or acting as counter batteries.
5. Exercises and drills in change of position and in munitioning and supply. These drills should include change of position to the front and to the rear, with corresponding change in supply system, and in the maneuvering and supply of an echeloned combat group.
6. This series is a resumé of what has gone before, which may be included in drills and maneuvers on a large scale with accompanying critiques.

Spain

[Course of Field Firing for 1917. Report from the Spanish Central School of Fire. *Memorial de Artillería*, Oct, '17. 15,600 words. 3 maps.]

(This is a detailed report on the conduct of field firing of Spanish artillery for the season of 1917. The special organization of batteries is first dealt with. This is followed by a schedule of the problems. The course includes 16 days of firing during the month of August and a series of conferences from Aug 31 to Sept 4. Besides these firing exercises there were preparatory drills and exercises including marches, camps, positions, battery reconnaissances, simulated firings, ammunition supply, aerial reconnaissance, replacement of casualties, and evacuation of wounded. The exercises themselves are given in detail, also the general and special situation for each exercise, orders and instruction to battery commanders, etc. The exercises included fire for effect. Several exercises were carried out with the help of aerial observers both on airplanes and captive balloons. One night problem was included in the course.)

—Maneuvers

See also

INFANTRY—MANEUVERS

—Matériel

Austria

[Data on Austrian Artillery Matériel, Field and Mountain. By G. Forni, Lt.-Col. of Artillery. *Rivista di Artiglieria e Genio*, Oct-Nov, '17. 1400 words.]

(A description, with plates, of the 10 cm. mountain howitzer, M. 16. The following are the most noteworthy points:

Breech mechanism, wedge. Carriage, long recoil, with hydraulic brake and spring recuperator. Sight, panoramic, with independent line of sight. Maximum elevation, 70°; maximum range, 8000 m. at 42°. Transport on three two-horse carriages, weighing 670, 730 and 750 kg. Ammunition, separate loading; shell, shrapnel and combination projectile; propelling charge, variable for five zones of fire.)

[The Military Equipment of the Armies of the Entente States. *Schweiz. Zeitschrift f. Art. u. Genie,* Mar, '18. 2650 words.]

Altho in time of peace we were fairly well informed as to the artillery equipment of the different armies, the longer the war lasts the more inaccurate becomes our knowledge. We attempt here to describe the present situation, basing our discussion on an article by Maj. Gen. Richter in the March, 1917, number of "Jahrbücher für die deutsche Armee und Marine." We deal with the artillery of France, Belgium, England, Russia, Italy, and Rumania, referring also to that of Japan since that nation furnished the Russian armies with guns, munitions, and officers.

All these armies were equipped with guns of about 7.5 cm. caliber, except that the English light batteries consisted of guns of 8.32 cm., and the horse batteries 5.7 cm., caliber. In all cases shrapnel and shells weighed between 6.5 and 7.24 kg. Generally shell and shrapnel weighed the same, but in the French service shell weighed 5.32 and shrapnel 7.24, resulting in different trajectories and consequent difficulty in interchange of the type of projectile. It is difficult to establish the practical effect of these differences. The heavy shrapnel, with its greater number of bullets, appears to have the advantage of greater probability of inflicting casualties; nevertheless if its trajectory is higher than that of a shrapnel containing fewer bullets, then the effect of the latter may be superior. In the case of the shell, a less perfect projectile may have better effect because of a greater number of fragments with greater penetrating power. In general artillery gains superiority by superior observation, range finding, and conduct of fire. The maximum range of artillery was from 8000 to 8500 meters for percussion fuses, and from 5500 to 6800 meters for time fuses, tho the Japanese had a maximum of 7200 meters for the latter. The French field gun takes the first place for effectiveness, because of its flat trajectory, penetrating power of shrapnel bullets, and greater range of its time fuse.

At the outbreak of the war, only England and Russia had light field howitzers. The English howitzers were 11.4 cm., the Russian 12.0 and 12.2. The former fired shell and shrapnel weighing 17.5 kg.; the latter 20.5 and 23.0 kg. Maximum ranges were 6500 and 7000 meters. The lack of field howitzers in the French Army was due to underestimation of the value of curved fire. With the increased use of cover, the value of this type of fire was more appreciated, and the French at first supplied the defect by an alteration in the head of the field shell which produced a more curved trajectory. The fire was inaccurate. Later the 10.5 cm. howitzer was developed; weight of projectiles 16 kg., maximum range 6400 meters, rapidity of fire, 12 per minute.

At the outbreak of war England had no heavy artillery with the field army. France had a short 15.5 cm. gun, while the other states had howitzers of about 15 cm. caliber. The Japanese also had a 12 cm. howitzer. All fired shell, and, with exception of the Russian howitzers, shrapnel, weighing about 40 kg. Maximum range was about 6500 meters. Russia and Japan also had guns of 10.67 and 10.5 cm. respectively, having a maximum range of about 9800 meters for percussion fire and about 8500 meters for time fire. Little is known as to the mobility of this artillery. Mechanical traction is largely used.

The position war resulted in the introduction at the front of fortress and naval guns, and the development of powerful new types. On the west front the presence of 12, 22, 27, 28, 30.5, 34, 38, and 40 cm. guns is announced. The French claim that 20 different types and 15,000 guns are in use. According to French newspaper reports, tests are to be made with a 52 cm. gun, which, according to whether it is handled as a mortar or as a naval gun will fire a shell weighing 1080 or 1930 kg., with an explosive charge of 315 or 580 kg. Whether the purpose of such enormous destructive power is to destroy armored fortresses or deep bombproofs is unknown. In addition to the large types, there are also pigmy types for local and special purposes in use in the trenches, with calibers as low as 3.7 cm.

With reference to the effect of the different types, Richter draws the following conclusions. Shrapnel has fulfilled all expectations. In maneuver war it must be the principal projectile against uncovered living targets. It cannot be dispensed with where uncertainty of range and mobility of target are combined with necessity for rapid fire. It is also more effective than shell to prevent the garrison of a work from appearing on the firing line to repel attack. For this purpose it is used by the attacker in position war, while the defender uses it to create a barrier thru which the attack can only with difficulty pass. The field artillery is suitable for this type of fire because it can reach a rapidity of 30 shots per minute when accuracy of aim of the individual shot is unnecessary. The field shell can also be used in barrage, since the range is known and the depth of the zone of fire small. Shrapnel with time fuse is also used to cover terrain where troops are known or suspected to be, to prevent the forwarding of reinforcements and ammunition. For this purpose the guns of the heavy artillery are most suitable, because of the range of the time fuse and the penetrating power of the shrapnel bullets, tho the rapidity of fire is inferior. Heavy field howitzers are also used for this purpose. Shell finds increased use against stationary living targets. The greater the caliber of the shell, the greater the number and impact force of the fragments, and the distribution. This characteristic of distribution in all directions is valuable against shield batteries. The shell of the light howitzer will break and scatter a gun into such small pieces that they cannot be found, and will, by air pressure alone, injure internal organs of persons. Consequently the objective of heavy artillery of the field army is hostile guns, fortifications, and wire en-

FIELD ARTILLERY—Continued

tanglements. But the principal use of the greatest calibers has been to utterly annihilate all hostile troops and defensive works under or above ground. Eyewitnesses testify that a German 42 cm. shell in Belgium penetrated 7 meters of earth and 2.2 meters of concrete. The defender has the consolation that the likelihood of striking an underground shelter is small.

In the Russo-Japanese war the Russian guns fell victims to the Japanese shrapnel. In this war the protective shields have prevented such result, but guns in the open have been unable to withstand shell. Thus the guns have been compelled to seek concealment and to employ indirect fire. The development of aircraft has compelled the introduction of anti-aircraft guns.

France

[Note. *Army & Navy Jour.*, Dec 1, '17. 200 words.]

In order to combat the German machine guns the French of late have introduced a new quick-firing cannon of such construction that it can be readily carried forward by attacking infantry, says the *United Service Gazette*. Thus the skirmishers are able to put enemy machine guns out of action by well directed shots from their 37-millimeter cannon, which they can carry along with them. The French "37" is a befitting companion to the famous "75," which has figured so prominently in the French campaigns to date. The smaller weapon has every feature of its larger brother, including quick firing breech mechanism, accurate sights and automatic recoil. Lying out on open ground, two men can fire up to thirty-five high-explosive shells per minute. The shells measure about one and one-half inches in diameter, and the gun has a range well above a mile for accurate shooting. This odd little field piece can be readily taken apart and carried by six or eight men, and is available for use in advanced positions as well as in the open. It is a most workmanlike piece of armament for use under the conditions prevailing on the western front.

Great Britain

[Impressions of a Visit to the French and British Armies in France. By Major Patricio Prieto. *La Guerra y su Preparación*, Feb, '18. 40,000 words. Photographs.]

Generalities on the British Artillery Organization and Equipment

Before the war England's army consisted chiefly of the Expeditionary Force—some 160,000 well trained men. Six divisions of infantry, one of cavalry, with complementary services, and with the following artillery to each division: 76 field pieces in 3 groups of three 6-gun batteries of 18 pounders (8.4 cm.); one group of three batteries of 6 light 4.5 howitzers; one battery of heavy (60-pound) howitzers. The artillery for the cavalry division consisted of four 6-gun batteries of 13 pounders (7.6 cm.).

In each infantry division the artillery formed an organic part of the division; of the 76 guns, 54 were light field pieces, 18 were light howitzers, and 4 were heavy guns.

Machine guns were in the proportion of 6 machine guns to 1000 rifles—the same proportion as existed in Germany before the war.

The present organization of the British Army in the theater of operations is as follows: The Army, the Army Corps, and the Division. Each army corps consists of three divisions of three brigades of four regiments each of infantry.

The artillery has been augmented by guns of the following caliber: 6, 9.2, and 12.0 inch and howitzers of 6, 8, 9.2, 12 and 15 inch caliber. Artillery is divided into four organic groups: divisional, army corps, field army, and cavalry divisional artillery. To these groups must be added the anti-aircraft matériel of 8.4 and 7.6 cm., and the trench mortars of 24, 7.6 and 5 cm. caliber, which are manned by the infantry units.

Divisional artillery includes the 8.4 rifles, and the 11.4 cm. howitzers (light type); army corps artillery includes 12.7 and 15.2 cm. rifles and 15.2 and 20.3 cm. mortars, while the field army artillery comprises rifles of 23.4 and 30.5 cm., with mortars of 23.4, 30.5 and 38.1 cm.

In time of peace, the British artillery was all in one unit known as the Royal Artillery, with two branches —the R. H. A. and the R. F. A., and a third group of siege and coast artillery, R. G. A. The brigade was the highest unit. Other more or less dependent units existed for the receiving and training of recruits and for the ammunition depots and storage. This organization has been preserved with the additions above mentioned.

Field artillery comprises horse batteries and light mortar batteries of six guns each and twelve munition carts. The firing battery consists of the six guns and six caissons. The battery is officered by one major, one captain and four lieutenants. Ordinarily three batteries are grouped under a lieutenant-colonel.

Theoretically there is a battery of six guns or mortars to each battalion. Due to the necessities of the present war, this proportion is not always carried into effect.

Batteries of heavy field artillery may be considered to be formed of that matériel which can be moved over wagon roads. Other calibers such as the 23.4 and 30.5 rifles and 30.5 and 38.1 cm. mortars are classified as pieces of great power or long range.

Batteries of 12.7 cm. rifles and 15.2 cm. mortars all comprise six pieces; batteries of 15.2 cm. rifles and 20.3 and 23.4 cm. mortars and howitzers comprise four pieces, and long range or great power pieces are always grouped two to the battery. All are commanded by a major, assisted by a captain and several lieutenants. Batteries are grouped in various manners both as to calibers and number of batteries, depending on the particular situation, and under lieutenant colonels.

The quantity of heavy artillery which the British had at their disposal was enormous and greater than that which the Germans could make use of.

It is generally conceded, even in the British Army, that the best number of guns for a battery, both tactically and technically is four; but there are a good many arguments in favor of six guns to the battery. According to the Artillery Commander of the Fourth British Army, the chief reason for the adoption of the six-gun battery in the British Army was the shortage of trained artillery officers and suitable artillerymen,

which necessarily limited the number of batteries.

Anti-aircraft artillery is always formed of sections of two pieces, mounted on automobiles. As to trench artillery, each division has a battery of four 24 cm. mortars and a battery of twenty-four 5 cm. mortars, the latter at the rate of four per brigade. There are two 7.6 cm. mortars per battalion.

Artillery Command; Officers, Soldiers, Stock

As before mentioned, the British artillery is divided into batteries and groups of batteries under a major and lieutenant-colonel respectively. All the artillery attached to a division is under the orders of an Artillery Commander with the rank of colonel. The artillery in each army corps is under the command of a brigadier general, who exerts his control chiefly over the heavy artillery, and the artillery ammunition supply for the army corps. Finally, all the artillery of a field army is under command of a general officer who exercises very general control of all artillery activities within the field army.

Before the war, all officers in the British artillery had taken a two-years' course at, and were graduates of the Royal Military Academy of Woolwich. The necessities of war made it necessary to increase the capacity of Woolwich and to supplement that academy by other schools and training centers from which a number of men could be graduated large enough to care for the great increases in personnel and fill up the vacancies due to casualties. These schools were organized with the purpose of training men morally, technically, and physically to command artillery in battle.

Several schools were established in England, and others were organized behind the front in France.

The schools in England prepare for horse artillery, field and heavy artillery. The course lasts four months after which the graduate is put on probation for one month attached to a home battery, depot, etc. He then takes a firing course, and after this is completed is attached to a battery for active service.

In the zone of each army in France there is an artillery training school for officers and N. C. O.'s, where the instruction is given in the new specialties of this war, such as trench mortars, machine guns, etc. There is apparently a school for cavalry officers and one for infantry officers.

As to the enlisted men of the Royal Artillery, they made a very good impression; always very neat, well dressed, and efficient.

Most of the live stock consists of draft horses, mostly of Irish, French, English, and North and South American stock. Many mules have been acquired for draft purposes during this war. They are used in munition and supply columns, and in some cases in the secondary lines of mounted batteries. Live stock is picketed in the open air, and is very well kept due to good feeding, and grooming, and to excellent veterinary equipment.

Artillery Matériel—Classification

The British field gun is known as the "18 pounder Q. F. gun." Some of its characteristics are: it is wire wrapped, nickel steel bore, 3.3 in. caliber, 29.4 calibers long, interrupted screw breech block, oil recoil cylinder, with spring counter-recoil mechanism, recoil cylinders above the barrel. The gun is mounted on a cradle which is pivoted centrally so that a variation of 3 degrees in deflection either way may be given. The piece has the independent elevating system and is provided with the most modern sights and angle measuring instruments. The axis of the piece is .936 m. above the ground; the wheels are 1.42 m. in diameter.

The shrapnel grenade used in the 3.3 inch gun weighs 18.5 pounds, carries 364 eleven-grain lead balls to a maximum effective range of 6500 yards. There is at present a high explosive shell loaded with TNT. The firing charge is cordite.

In the firing battery each gun caisson carries 24 rounds and each caisson chest 76 rounds. Each gun has a total of 176 rounds—less than the guns of the French and Spanish batteries, which are supplied with 283 and 312 rounds respectively.

The light howitzer, type 1912, used with divisional artillery, is called the 4.5 inch howitzer. It has a large shield which protects head and body of gun crew. The weight of the piece in battery is 1340 kilograms, it is 16.2 calibers long and fires at all angles of elevation up to 50 degrees.

British artillery is built at the Woolwich Arsenal, the Coventry Ordnance Works, the Armstrong Works in Elswich, and at the Vickers-Maxim Works at Sheffield.

The 60-pound 12.7 cm. cannon is 33.6 calibers long, has hydraulic recoil and spring counter-recoil system in tubes above the barrel and fires a 27.2 kilogram explosive shell 14,880 yards at an initial velocity of 2000 f.s.

Ammunition is not carried in gun limbers of these guns, but in caisson chests.

At present the shell for the 60-pound cannon is separate from the powder charge—no cartridge case is used. This gives many advantages in transportation at the expense of rapidity of fire.

I saw a battery of these guns located near Sapignies on the Bapaume-Arras road, firing at the first trench system of the Hindenburg line at a range of 8000 meters. The guns and caissons were along side of each other—both covered with branches. The fire was indirect and controlled and directed by airplane. There was a small wooden house behind this battery position, surmounted by a wireless antenna, and housing a wireless receiving set. No defensive works whatever had been constructed around this battery, as the Germans were then on the tretreat and the English had nothing to fear from German long range guns.

The British 6 inch cannon is a marine rifle built by Vickers and adapted to a field mount on wheels. It fires a 100-pound shell to a maximum range of 17,000 meters. The piece has no shield.

I saw a battery of four 15.2 cm. guns near the battery of six 60-pounders before mentioned, firing on the Queant station at a range of about 12 kms. The battery fired at the rate of one round every 2 or 2½ minutes. Fire was indirect and the guns were laid in azimuth with panoramic sights from an aiming point, and in elevation with a level instrument. The recoil is hydraulic, but is not entirely taken up by the recoil mechanism so that recourse is had to hillocks under the wheels so that at discharge the gun is pushed backwards

FIELD ARTILLERY—Continued

up a short incline and then rolls forward into battery of its own accord. The guns were not protected by defensive works and were simply camouflaged with paint splotches of many colors.

The 6-inch howitzer Vickers Model is a piece of recent construction, which has been developed during the war. It fires the same high explosive shell as the 6-inch rifle, at an initial velocity of 390 meters per second. This low muzzle velocity gives a muzzle energy of 351 meter-tons, and a range of 10,000 meters. The barrel is 13.66 calibers long. Unlimbered the gun weighs 3712 kilograms and limbered 4296 kilograms.

In the vicinity of Wlamerthinghe Castle, between Ypres and Poperinghe, I saw batteries of 60-pounders and howitzers of 23.4 cm. and 30.5 cm. in action. The 23.40 cm. howitzer is mounted on wheels for transport, the power being furnished by caterpillar tractors. The piece and cradle are separated for transportation.

The 30.5 howitzer is transported on and fired from a railroad mount. In firing, the gun and carriage are raised on supports so as to take the reactions from the discharge off of the truck axles.

There are some pieces used for direct fire of 15.2 cm. caliber and higher, such as the 9.2 and 12 inch rifles on railroad mounts.

The most outstanding feature of the anti-aircraft artillery is the sighting apparatus, consisting of various instruments. Guns and sighting instruments are all mounted so that large vertical sectors can be rapidly covered.

For firing, the automobile upon which anti-aircraft guns are mounted, is raised above the ground on four shoes so that there will be no undue strain on the wheels or axles.

As to trench mortars: the 24 cm. mortar is a tube with a reduced space at the breech used as a powder chamber, for the disks of smokeless powder which form the firing charge. This tube is mounted on a metallic cradle which is in turn mounted on a small frame with wooden shoes or skids on which it rests on the ground. The mortar is taken down into four parts for transportation by hand. The projectile fired by this mortar carries a 60-pound powder charge to a range of 1100 meters.

The 5 and 7.6 cm. mortars both have their most suitable mission in the destruction of barbed wire entanglements, which fact is due to the peculiar fragmentation of the trench mortar projectile.

The 7.6 mortar throws a cylindrical ogival shell to a maximum range of 600 yards. It is provided with a silencer, which is an extremely important feature as in these low muzzle velocity, short range guns a man has time to jump out of the way of the shell if he hears the explosion. This piece is a very rapid firer. A well trained crew can fire 30 shells per minute from it. The projectile has a special percussion fuse which will function regardless of the point of impact. This 7.6 matériel is light enough to accompany the infantry in its advances. Trench mortars are built almost exclusively by the North British Locomotive Co. The 7.6 mortar was invented by Mr. W. Stokes.

From my observations, I believe that the most used heavy guns are the 60-pound rifle, the 15.2 cm. rifle and the 15.2 and 20.3 howitzers. These are followed in utility by the 23.4 and the 30.5 and 38.1 howitzers in the order named, which, like the 23.4 and 30.5 rifles, have a very limited use due to the difficulty of munition supply.

Artillery Traction

The following table shows how the artillery is transported in the field:

Type	Caliber	Traction	No. of draft animals, etc.	Remarks
Gun	7.6 cm.	Horse and sometimes mule	6	
Gun	8.4 cm.			
Howitzer	11.4 cm.			
Gun	60-pounder	Horse	4 to 6 teams	15.2 cm. howitzers are hauled by F. W. D. trucks. Other types by Holt caterpillar tractors of 75 and 150 hp. gas engines. F. W. D. trucks travel 20 km. per hr.; tractors only 5.5 km. per hr. Tread of caterpillars usually 60 to 75 cm. wide
Howitzer	15.2 cm.	Tractors, auto, or caterpillar	1 per piece	
Howitzer	20.3 cm.			
Howitzer	23.4 cm.			
Gun	15.2			

Guns of more than 15.2 cm. caliber and howitzers higher than 23.4 are transported on railroad mounts.

Munition Columns—Ammunition Supply

The ammunition supply system for the present extensive artillery has all been developed during the war. The supply is divided as follows—with the battery, with the ammunition columns of battery groups or light batteries, with divisional ammunition trains, in the ammunition dumps. The quantity is as follows: 176 rounds per gun wth the battery (horse and mounted artillery), 108 in the case of the light howitzers, and 80 in the case of heavy guns. The total with the battery, column, and dump amounts to 1000 rounds per gun of a cavalry and infantry divisional artillery, 800 rounds per howitzer, and 500 rounds per 60 pounder.

According to the Artillery Commander of the Fourth Army Group, columns have been replaced by divisional ammunition columns with horse traction, and army corps and field army columns with motor truck traction.

To-day the "explosive grenade" shell is issued in the proportion of 50 to each 100 projectiles of other kinds. 12.7 and 15.2 cm. rifles and light howitzers fire both high explosive and "explosive grenade" shell, while the other howitzers and the long range guns only fire the latter type.

The high explosive and "explosive grenade" shells fired from light pieces have a double effect fuse, all other shells have a simple percussion fuse which does not have to be set before firing.

For a long time England suffered a great deal from lack of both quantity and quality in her artillery ammunition. During the first eighteen months of war Woolwich Arsenal was practically the only production center. In May, 1915, there was a change in the Ministry with the result that a Ministry of Munitions was created, and the work of producing artillery ammunition was co-ordinated and enlarged so that an ample and continuous supply soon became available.

Lloyd George's powerful personality was the force

that mobilized all the industries so that in less than one year there were twenty-two explosive factories, eighteen trench mortar and artillery shell factories, six small arm and cannon ammunition factories—all government owned, besides thirty-two field gun shell factories, twelve heavy artillery ammunition factories. By the end of 1916, the British Government had 4000 centers of production for war supplies, where there were employed 1,250,000 men and 250,000 women.

In instituting these changes, labor conditions were entirely upset. Laborers and medium workmen had to be substituted for skilled mechanics. Training schools for specialized laborers were established. The Health of Munitions Workers Committee and the Welfare Department of the Ministry were organized in order to care for the health and social betterment of government employees, besides arranging for pensions, longevity pay, etc.

In the early production of explosive shells it was noticed that many cases of premature explosion took place owing to deficiencies in fuse construction. In order to prevent these accidents a corps of inspectors was established and educated at the Ordnance College. There are at present 14,000 women in the total strength of 30,000 inspectors. Their work has been excellent in assuring a production of reliable ammunition.

At the time this memoir is being written, there is an abundance of ammunition in England and behind the British lines in France. The ammunition dumps and arsenals are always filled to capacty with every caliber of ammunition. The Ministry is responsible for this, as it has absolute control over all production and manufacture of every nature. If a concern or an individual is engaged in making photographs, the Ministry of Munitions may cause him to entirely or partially change his product into something which will help to win the war.

[The author describes a visit made to the Woolwich Arsenal in England and gives some data on the rate of production and methods of manufacture of guns, fuses, munitions, and mountings. The idea at Woolwich is, in short, to produce the greatest quantities of everything in the shortest possible time.]

Tactical and Technical Employment Effectiveness

At the time of our visit the British Army had completed its forward movement between Arras and Soissons. It is my impression that the field artillery training regulations, as such, were not used to any great extent in the handling of the British artillery in this drive or in the following ones.

In general the heavy artillery is used to support the attacking divisional artillery in the destruction of obstacles. The light artillery destroys the entanglements and lays down the barrages, besides bombarding all important points of concentration or communication either for men or supplies, behind the enemy lines. The heavy artillery is only used against troops in reserve, in order to separate them from the first line troops, or in order to isolate the fighting zone from the cantonment and billeting zone.

In order to assure an effective bombardment of enemy batteries, the English first take great pains, to protect their bombarding batteries from all aerial observation; next the batteries are always placed near a road and behind some natural fold or ridge in the terrain.

Consequently, in addition to the inaccuracy of long range fire these heavy bombarding batteries are subject to the errors due to an obstructed field of view. One fact must be borne in mind at all times, namely, the guns engaged in a bombardment against hostile pieces must be of a longer range, or more effective than the pieces attacked. As heavy guns are primarily built for the purpose of facilitating the infantry advance, and as in doing this they are bound to, sooner or later, encounter opposing guns, the artillery duel will be the inevitable result. It is in this duel that superiority in power and range is of the greatest value.

Trench artillery has been developed more than any other type of artillery during this war. This is true in every army that is engaged. The expansion has been so great that types have been assigned to different missions, calibers have been systematized, and ammunition has been built for the various tasks entrusted to trench mortars.

Co-operation between infantry and artillery has been the chief care of all the general staffs. In order to insure this, both arms are provided with every means of communication.

Most of the artillery firing is indirect, consequently the artillery is beset with many purely technical problems in its fire control and correction.

Airplane reconnaissance is of the greatest help in procuring effective artillery fire. In the British Army, each army corps has one or more air squadrons assigned to it solely for artillery observation purposes. Quadrangled maps are used to ensure co-ordination between the different artillery commanders. In general these maps are on a scale of 1:20,000 and have three sets of quadrangles. The first set marked with capital letters contains 36 of the middle set marked with numbers (1 to 36 inclusive) which are 1000 yards to a side. The middle set in turn contains four small quadrangles marked a, b, c, and d, which are 500 yards to a side.

Airplane photographs are used in connection with these quadrangles.

The co-operation of airplanes with artillery batteries had been studied out and made the subject of regulations before the war. (In the British Army Regulations of Apr 9, 1914.) These regulations have been improved and extended with the development of aviation. The best method of communication between airplanes and batteries is as follows: The airplane sends wireless messages, but receives messages sent by prearranged visual signals arranged on the ground.

The Royal Flying Corps and British artillery officers are most eager to improve and augment their various branches in every way possible. I found that these officers had a very high order of morale, and were extremely efficient in all their duties.

United States

[Fortifications Bill. *Army & Navy Jour.*, June 29, '18. 2200 words.]

Representative William P. Borland, chairman of the

FIELD ARTILLERY—Continued

subcommittee that prepared the bill, issued a statement concerning it at the same time that the measure was reported to the House, in which he described the bill as being "a measure to provide scientific armament for a modern army." He continued:

"This bill is like no other Fortifications bill ever presented to Congress. It is necessary to understand the theory upon which it was drawn. The paramount need of the hour is to provide for an ample program of field artillery for the use of the army in Europe. The other items in the bill must be subordinated to this, not because of lack of merit, but because of relative importance. The biggest items in the bill are the appropriations for mountain, field and siege cannon, and for ammunition for the same. For the artillery program $500,000,000 is allowed in cash and $729,731,295 in contract authorization, making a total of $1,229,731,295. For purchase and manufacture of ammunition for these guns the amount allowed is $2,000,000,000 in cash and contract authorization of $1,793,734,550. These two items provide for a program for three armies, each army consisting of 1,375,000 men. It was formulated by General Pershing, approved by the Allied War Council in Paris, and by the General Staff of the War Department here.

The Gun Construction Program

"A certain number of field guns are allotted to each division, corps and army, and in addition to this there is a program of heavy ordnance embracing the ten, twelve and fourteen-inch guns and the sixteen-inch mortars. Included also are a number of guns that have been transferred from the navy for use of the army. Some of these are spare guns of the most modern type which are a reserve stock for the fleet and not actually needed for the equipment of any naval vessel. Others constitute obsolete guns of short range which are no longer used upon American vessels, but which are very serviceable for land use. In addition, there are a number of coast defense guns running from five to twelve inches, which will be mounted on railway carriages and on motorized trailers. None of these are taken from important fortifications in the United States, but are principally from the spare guns of the reserve stock of the Coast Artillery. The committee felt willing to encourage the use of all of the guns which are immediately available. As between the coast fortifications in this country and the battle line in France the important need for guns is, of course, in France.

"This program of gun construction is so large that it has taxed to the utmost the production resources of this country. The hearings disclose that General Pershing is now purchasing in France field artillery equipment for thirty divisions of the American Army, including both guns and shells. The French are meeting these orders, and in fact are delivering the supplies faster than our troops require them. For the last few months the American troops have been brigaded with the British and French, which means that they have been using the ammunition of those forces instead of using our ammunition and weapons. For this reason the surplus of guns and ammunition has been piling up in France ready for delivery to the American forces. It is calculated that all of the field artillery and ammunition needed for the American forces in France between now and January, 1919, will be supplied from French sources, and in the meantime we will attain quantity production in this country.

Munitions Plants Program

"In order to facilitate production of guns and ammunition, the War Department has invested various sums in increasing the facilities of the factories in equipping men for this munitions work. These investments run from $26,000 up to $2,500,000 a factory. The big gun program will necessitate the construction of a complete United States manufacturing arsenal. One has been located on an island below Pittsburgh, where the United States will manufacture guns from the steel ingot up to the finished weapon. The large program for shells and ammunition also includes developed facilities all over the country. These facilities include nitrate plants, powder plants, acid and chemical plants, shell filling plants, bag loading plants, and plants for recovering toluol from manufactured gas, from California petroleum, and from the by-products of coke ovens. The program for the manufacture of powder and explosives is designed to make the United States independent of all foreign supply in this important factor in modern warfare. The bill provides also for an extensive program for searchlights and anti-aircraft defenses. It provides for eight permanent anti-aircraft coast defense stations, to be located at the discretion of the War Department. The committee found upon careful hearing of the Department that there were now a number of aviation stations along the Atlantic coast, which were available for emergency defense.

"The program for the construction of permanent fortifications and works of coast defense has been subordinated to the program for artillery in the bill. No new work of any magnitude is being authorized in the way of coast defense, and a large amount of money which was appropriated for this purpose in the Defense Act of Oct 6, 1917, has been voluntarily surrendered back by the Department. The reason for this is that the committee and the Department agree that in the present shortage of labor, material and transportation in this country, no labor or material ought to be diverted to permanent works fortifications until the program for the equipment of the army in France has been fully provided for. It was thought that no additional burden should be put upon the manufacturing or transportation facilities of this country, and no large number of mechanics should be taken away from more important work to build fortifications which could not be ready within any reasonable time, and which, if built now, would cost the very maximum amount for labor and material.

"An appropriation of $1,500,000 is made for the expense of the operation of the proving grounds at Aberdeen, Md., and Sandy Hook, N. J. These proving grounds are working to capacity in testing the guns and shells that are manufactured for the use of the army abroad. Six million three hundred thousand is

granted for additional facilities at the proving ground at Aberdeen.

Covers Panama Defense

"The bill includes not only the fortifications in the insular possessions, but for the first time it includes also an appropriation for the defenses of Panama. The Panama appropriations have formerly been carried in the Sundry Civil, but by agreement between Mr. Sherley and Mr. Borland have been transferred this year to the Fortifications bill. An extensive program for the increase in the defenses at Panama has been projected by the War Department and was submitted to the committee this year. It was not entered upon, however, for the reason that it would absorb labor and material from this country and could not be counted upon to add to the practical defense of the canal in the present emergency.

"Instead of being called a 'fortifications bill' this bill ought to be entitled 'the bill to provide scientific armament for a modern army.' It is devoted to the most modern form of field artillery, ammunition, explosives, trench mortars, anti-aircraft defenses, gas bombs, railway mounts, motorized batteries, aviation, and other items which have scarcely appeared heretofore in the Fortifications bill. It illustrates the transition stage between the massive fixed fortifications of the pre-war period and the light, mobile, scientific defenses of the present day. It puts Uncle Sam's Army abreast with the most modern discoveries of the age and will, when carried out, equip this army in the way of field artillery and auxiliary weapons, both in variety and extent, as no other army has been equipped in any war in history. To my mind the program of field artillery does not indicate that we expect to confine our efforts to trench warfare, or even to open field fighting. Ample provision is made in the field artillery and in the trench mortar program for this kind of contest. The heavy guns are not needed against personnel, but are used only against fortifications and defenses of considerable strength. While no plans were laid before the committee other than the plan of equipping 3,000,000 men for field operations in France, and therefore any surmises indulged in are personal only, I can draw from this program of big guns but one inference, and that is that the American Army will be prepared to cross the Rhine in full force and full strength commensurate with any obstacle which it may encounter."

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[Artillery and Aviation—Their Employment and Liaison in Modern War—Part II. By Carlos Martínez de Campos, Capt. of Artillery. *Memorial de Artillería*, Apr, '18. 10,000 words. — figures.]

The essential conditions in all modern artillery are that a sufficient variety of calibers and mountings be available so that the fire of a gun of any power will not have to be met with one of lesser power.

Major Grassit, in commenting on the use of 75 mm. guns, states that their mobility, longer range, and rapidity of fire made them effective against German guns of 120 and 155 mm. Nevertheless the French artillery has undergone a complete reorganization, so that pieces of every caliber and on adaptable mountings are now available for any particular purpose. The battle of Charleroi is an example of defeat because of insufficient artillery armament. The 75 mm. gun, tho a wonder in its class, was unable to compete with the German large and super calibered guns. The battle of the Marne is the supreme argument in favor of 75 mm. artillery. As a matter of fact the heavy French artillery, tho not well represented in this battle, was at least partially responsible for the German retreat.

Divisions and army corps are at present using matériel of 7.5 and 10.5 cms. which was used by Germany before the war.

England based her army organization upon the possession of a very powerful heavy artillery, which first appeared in the battle of the Somme in the shape of 15 inch cannon on railway mounts, firing at the rate of one round per minute.

The heavy Austrian mortars which were so ridiculed at the opening of the war have been rapidly imitated by the other countries, which have built mortars of 52 cms. caliber that can barely be used.

Everything in this war has been on a grand scale, and the idea that Spain can put herself in a state of defense with a small series of 12, 15 and 21 cm. cannon is ridiculous.

As to the 75 mm. matériel, there are some changes in the present mounting which appear essential. The piece should be able to fire at all angles of elevation up to 90 degrees. The preservation of light artillery matériel is based upon this condition.

The possible disappearace of all 75 mm. guns is based entirely on their lack of power and short range. If our enemies give up the 75 mm. type, they will probably substitute for it the 10.5 cm. type with a range of 10 to 11 kilometers and a projectile weighing from 18 to 20 kilograms. This 10.5 cm. gun, if employed in sufficient quantities, will make our light matériel (75 mm.) useless. It is not as mobile as the 75 mm. gun, and this lack of mobility will increase as the terrain on which it is being used becomes rougher.

The chief tasks of our light artillery will be. the formation of barrages, and the silencing of enemy 10.5 cm. cannon. The 75 mm. gun has no equal in the former task, providing the gun can fire at any angle up to 90 degrees. On the other hand, both the 75 mm. and 10.5 cm. guns are useless in silencing the enemy 10.5 cm. guns. In this case a gun 12 cm. in caliber with 13,000 meters range or a howitzer of 15 cm., with a minimum range of 6000 meters, will be the only effective weapon.

Due to our geographical and topographical situation in Spain, an enemy would have some difficulty in handling guns of 10.5 cm. caliber.

If our enemy retains the 75 mm. type field piece, we must still have the two types—10.5 cm. for destroying enemy batteries and 75 mm. for barrage work.

The chief tasks of howitzers and mortars are the destruction of cover and defenses, and the destruction of personnal. The O.12 cm. L/14 Krupp howitzer is probably the best howitzer to use against troops protected by accidents of the terrain, as it gives the most effect with the smallest consumption of ammunition. However, in Spain, where the caliber system should

FIELD ARTILLERY—Continued

be unified as much as possible, the best howitzer for our purposes is of 15 cm. caliber.

THE MODERN ARTILLERY SYSTEM

Heavy Field Guns. Most of the nations at war have 10.5 cm. and 12 cm. field pieces which have given excellent results. The results achieved with the 13 cm. Krupp gun by the Germans are not yet fully known.

The 12 cm. Krupp firing 100 rounds at 6000 yards can cause between 107 and 642 casualties. Eleven rounds fired in 2 minutes 12 seconds from this gun produce the same effect as 100 rounds in 5 minutes from the 75 mm. gun, and the 100 rounds for the latter gun require four times as much transportation as the eleven rounds for the former.

It would seem that the 12 cm. was without doubt the better gun, but when the effective range, efficiency, rapidity and velocity of fire are considered as well as the transportation difficulties, the most effective weapon against live targets of infantry or cavalry is the 150 mm. C. Ac. gun. The 15 cm. cannon should be the basis of our heavy field gun system.

In order to illustrate the efficiency of the 15 cm. caliber guns, the author assumes a situation in which opposing forces are entrenched. Our artillery is arranged in four zones at intervals of two kms., the trench artillery and mine throwers in the first, 7.5 cm. cannon and 15 cm. howitzers in the second, 15 cm. cannon and 30 cm. mortars or howitzers in the third, and the 30 cm. cannon in the fourth line. The enemy's position is similarly organized in four lines. The effective zones of the various calibers are illustrated by figures, and the conclusion is reached that the most effective general utility weapons are the 15 cm. guns and howitzers.

Large Calibered Guns. These are necessary to prepare the infantry advance. The 15 cm. guns and howitzers are not powerful enough to destroy dugouts and concrete construction underground. The only conclusion that can be deduced from the war, insofar as the necessary ballistic conditions and transport conditions for high calibered guns are concerned, is that the gun should not be less than 28 cms. in caliber, with a range of not less than 10,000 yards, and an explosive charge of at least 16 to 20 kilos.

Once the necessity for these high calibered guns is recognized and the lowest caliber acceptable is fixed at 20 cms., it appears that the most acceptable caliber is 30 cms. This gun will be effective in the attack when the enemy has withdrawn four kilometers and is out of the range of the 75 mm. and 15 cm. guns.

The article is concluded with a proposed organization of army corps artillery for the Spanish Army. This proposal includes artillery from the 1906 model 75 mm. gun to the 30 cm. guns and mortars. It totals 134 pieces of mixed type and of 75 mm., 15 cm. and 30 cm. caliber.

A provision is made, that in case the war proves the proposed system to be ineffective, three batteries of four 15 cm. howitzers can be added to the proposed system, making a total of 158 guns, mortars and howitzers.

[Use of Artillery Matériel Taken From the Enemy. By Patricio Prieto, Maj. Artly. *Memorial de Artillería*, Feb, '18. From a French Text. 25,600 words. Figures.]

(The original should be read.

The author takes up the German 77 mm. gun in detail, giving weight and description of each part of gun and carriage. Weights of main parts of gun and carriage are tabulated. Similarly the gun limber, caisson chest, and limber are discussed. All descriptions are referred to named sketches.

The various types of projectiles and fuse used in this gun are also discussed with figures.

The original of this article appeared in a French text and the title of this particular gun was the "75 mm. field gun." The descriptions, however, prove it to be the German 77 mm. gun. The Spanish translator ventures the opinion that this mistake was purposely made in order to hide the identity of the famous French 75.)

[Artillery Direction Points. *Schweiz. Zeit. f. Art. u. Genie*, Apr, '18. 5800 words.]

The development of a basic scheme of artillery equipment must rest upon the demands of the effect principle, which determines the requisite type of guns and ammunition, and of matériel for laying, observation, communication, and traction. The principles of application and organization must exercise a secondary control over the scheme of equipment, being themselves subordinate to the need of employing all available matériel for the maximum effect. A simple but rigid numerical scheme has no value. Fluidity and ready adaptability to the needs of the military situation must be the determining factors. The equipment scheme must depend on the conjectural character of the war, peculiarities of the terrain, and financial resources.

In case of a war of maneuver, mobility is as essential as effectiveness, while in purely defensive warfare mobility sinks into the background in favor of sufficient power to hold the enemy at a distance. Switzerland's foreign policy has for centuries been one of non-intervention. This with its military inferiority to surrounding nations determines its military policy, which is a strategic defensive. The entire scheme of equipment must therefore be such as to convince any belligerent that an attempt to force a passage thru Swiss territory would not pay. A militia army can best maintain a strategical defensive by supporting itself on fortified places. On this principle, immediately upon the opening of the war we completed the construction of the Hauenstein and Murten positions. For the effective defense of fortified positions, a generous supply of heavy and long-range guns is essential. As the defense of a position consists chiefly in keeping the attacker at a distance as long as possible, it follows that a part of this artillery must have the maximum possible range—in other words, must be guns. Nevertheless there must be howitzers, in order to reach the covered works of the attackers. Mortars are less necessary, as the attacking artillery seldom has overhead armor protection. They are needed, however, in defense of mountain positions. As the policy of

neutrality requires defense of the boundary, anti-aircraft guns must be added.

The character of the terrain influences the ability to maneuver, and determines the most desirable form of trajectory. Mountainous or varied ground opposes obstacles to the transport and use of heavy batteries, often rendering them an impediment to maneuvering instead of a means to victory. Installation of special mountain artillery such as mule batteries is a resource for critical circumstances. Such artillery lacks the capacity for rapid advance; it must be moved and operated in disadvantageous positions; its placing and use requires greater training and practice than is the case in open and level terrain. Effective organization and direction are necessary conditions.

In mountainous country a delicate problem arises as to the proper proportion to be established between light and mountain batteries. The complete substitution of mountain artillery for light artillery is precluded by the inferior effect and mobility of the former. The use of pack-animals requires lighter construction, necessitating a lighter powder charge than in the case of guns of the same caliber in the light artillery, also a shorter bore, which results in diminished muzzle velocity. The projectiles must be smaller, diminishing the capacity for shrapnel-bullets and explosive charge, and the resistance to deviation by the wind. The slowness of maneuver precludes the rapid shifting from place to place required of artillery. The supply of ammunition transported with each mountain battery must of necessity be more limited and its renewal more difficult than is the case with light batteries. At the same time light artillery cannot entirely take the place of mountain batteries, and enough of the latter must be provided to accompany the mountain units of the infantry.

The conjectural character of the war helps to determine the type of guns in mountain batteries, since for defensive fighting the effect principle demands not only light guns but also heavier and more efficacious guns and howitzers. At the same time it must be remembered that a complex mixture of artillery types within the same army corps augments and complicates the task of supply, particularly in maneuver war.

In warfare on varied ground, even guns call for a diminished muzzle velocity—such a trajectory as characterizes our 8.4 cm. cast steel gun. This entails a diminished penetrating power of the shrapnel bullets, but avoids so many dead spaces, which would have to be enfiladed by special batteries. The former system of supplying field batteries with weapons both for direct and for curved fire was abandoned by us to simplify training. The invention of a model which would combine the properties of both types would afford several advantages. It would supply the means of demolishing covered battery positions and would introduce simplicity and economy into the equipping of artillery.

Limited financial resources necessitate the most painstaking care, for solving the equipment problem in a way to secure the maximum preparedness for the army. Prejudices and prepossessions toward any type of gun must give way. All experiments must be judiciously ordered, needless repetitions being avoided where reliable information of earlier experiments is obtainable. Initial tests should not involve large quantities of matériel, if individual experiments can be conclusive. All tests should be practical and thoro. It is poor economy to forego even a costly experiment whose omission leaves the business of equipping to proceed on insufficient information. By way of illustration, if Switzerland had blindly supplied certain guns proposed by the technical commission and the military department, millions would have been wasted, leaving our field artillery still in the condition of Italy's preceding the outbreak of the present war.

A nation which does not have an inexhaustible treasury must, in order to make its equipment conform to the effect principle, avoid weapons for which there is not an available munition supply and a reserve of raw materials. The present war has taught that the reserve must be greater than was formerly thought, and that foreign supply during the war cannot be relied on. A country which lacks a metal supply must therefore lay in a large reserve in time of peace. Similarly a nation must produce its own gun materials. For this reason Austria--Hungary has given up cast steel guns, and has turned to the bronze supply which is available at home. The difficulties of home manufacture in our metalless country are well set forth in an article in the *Neuer Züricher Zeitung*. The article cited argues that the best is none too good for the army; that years would elapse before a domestic factory could compete in quality with already established foreign factories; that such a factory could not be kept continuously occupied, as domestic demands would not be sufficiently great in time of peace, and as the Swiss factory could not compete in foreign markets against old established institutions. The great powers of Europe and the United States manufacture their own weapons; Spain and Sweden export weapons; Norway and Denmark buy from Sweden; the Balkan and the South and Central American States buy only where they have obtained loans, which Switzerland could not furnish. Holland would not buy in a new market unless a better article were furnished. The article further argues that the business would be a failure in time of peace, while in time of war conditions would be even more unfavorable because of the restrictions on the importation of raw materials. Furthermore, the war-time demands could not be met. True as these observations are, nevertheless domestic manufacture is a necessity in order to make us independent. The objections are all financial. They can be met by a government owned or subsidized factory.

For years the strength of the artillery was based on a proportion to the whole number of combatants. In general, the ratio has been greater at the end of any war than at the beginning, and the proportion has had a general increase from the Silesian War when it was 2 per 1000, to the year 1905 when the German army had 5.75 per 1000. This proportional scheme has been discarded. Napoleon used his artillery as circumstances demanded and as the means at hand permitted. This is the rule in the present war. At a conservative estimate the Allies used 4000 guns

FIELD ARTILLERY—Continued

and trench mortars in the artillery preparation on the 20 km. front on Easter Monday, 1917.

In conclusion, the equipment and the effect principle must go hand in hand, and the former depends not only on technical details, but also on the conjectural character of the war, special circumstances, and financial resources.

—Matériel—Small Caliber Ordnance

See also

FIELD ARTILLERY—MATERIEL—FRANCE

[The Infantry Cannon, Model 1916. By Col. Francisco Echaguey and Col. Juan G. Benitez. *La Guerra y su Preparación*, Nov, '17. 500 words. 1 photograph. 2 figures.]

This is a naval rifle 37 mm. caliber, with a short barrel, and mounted on a special cradle. Its characteristics are mobility, rapidity, and accuracy of fire. For transportation under fire, it is separated into three parts—gun, brake, and trail. All three pieces are carried by hand. On the march, it is mounted on two wheels, and locked to a small limber, both of which are drawn by one horse. The weight with brake is 47 kilos; the weight of the trail is 37 kilos. A single bolt locks all parts together. It is provided with a telescopic sight and two pointing devices. It is laid in direction by means of a horizontal screw and a wheel with a spiral gear. A second wheel moves it in elevation.

The effective range is 1500 meters, at which distance the accuracy is remarkable. The trail is split. The breech block, brake and recoil mechanism are the same as in the 75 French field piece.

The gun fires either a cast iron shell weighing 450 grams or a steel projectile.

The gun is served by a sergeant, who is the chief of section, a loader, a gunner, and four ammunition carriers.

—Matériel—Trench Mortars

[The History of the Mine Thrower. *Norsk Militaert Tidsskrift*, Feb, '18. (Main source: *Illustrirte Zeitung*.) 2750 words; 9 illustrations.]

After a description of its use, the author proceeds to the history of the development of the mine thrower.

The beginnings of the mine thrower in a modern sense were made during the Russo-Japanese war, especially during the battles about Port Arthur.

After a slow and dearly bought advance, the attacking forces had arrived at a distance of a few meters from the defenders, separated from them only by the barbed wire fences which were steadily renewed and under the most deadly rifle and mitrailleuse fire.

The Japanese had learned, by heavy casualties, that storming thru unbroken obstacles was impossible in front of a wide awake defense. Breaches would have to be made in the line of obstacles. The artillery could not be used on account of the proximity of the fighting lines. Under these circumstances, the engineers had to make breaches in the barbed wire fences by means of scissors or explosives, which was slow and difficult. The work could only be undertaken at night against the less wakeful defense. The Japanese engineers pushed, rolled or threw bombs with lit fuses into the obstacles and quickly ran back to cover. In this way a 10-meter breach was made in the barbed wire fence: this was not enough. The work had to be continued, slowly and under great losses, until the breach was wide enough.

Then came the idea of an apparatus by means of which the bombs could be thrown into the obstacles. The Japanese mine thrower originally consisted of a bamboo pole strengthened with bast which was spun around it and containing a gunpowder charge of ½ kg. to be lit by means of a fuse. The accuracy of aim was, however, very small. But the mine thrower brought confusion within the Russian trenches; tho it had little effect against the obstacles.

After the Russo-Japanese war Germany took up the new idea. It was confided to the engineers, harmonizing, as it did, with attack and defense of fortifications. They soon found that less than 50 kg. would have little effect against the barbed wire fences and other obstacles. The trajectory would have to be high, the accuracy of aim very great, and the weight of the mine thrower reasonable, so that it might be brought into the first line positions even in the most difficult ground.

At first the mines were thrown by mechanical apparatus, something like the ancient catapults and ballistas, which had the advantage of not betraying their position by smoke, fire or report. They had to be made too cumbersome, however, in order to be able to throw 50 kg., and the accuracy of aim was unsatisfactory.

The old smooth bore mortars were then tried, but without favorable result. In order to obtain accuracy of aim, the rifled bore and gun carriage provided with recoil had to be adopted. Of this type three mine throwers have been constructed, the heavy, medium, and light one.

The heavy mine thrower is made for charges of 100 kg., caliber 22-25 cm., best range 200-300 m. It is charged from the muzzle. The mine thrower may be put in a carriage and pulled by six men.

The medium one is built according to the same principle as the heavy one, but the range is double, caliber 15-17 cm., charge 50 kg. This mine thrower may also be put on a carriage and pulled by six men. It was originally made for the defense of forts. Both mine throwers may be taken apart for transport.

The light mine thrower is used against troops and to destroy lighter defenses made of earth. Caliber 8 cm., range about 800 m., charge 1 kg. It needs three men for service and transport, but may be put in position by one man. It may be put on two small wheels, carried by two men or one horse. The rapidity of fire is very great.

In the beginning of the war nobody had an idea of the great importance which the mine thrower was going to have. The Germans had got the start of the Allies in this respect.

During the course of the war the compressed air mine thrower has been invented. It is breech-loading. The driving power is compressed air. It has great accuracy of aim, as the pressure corresponding to the

distance may be regulated by means of a manometer. It is used for small mines and short ranges.

Mine thrower companies and battalions were shortly formed to be attached to the larger units.

The mine thrower is mainly meant for attack, consequently it is placed in the fighting zone and in intimate connection with the infantry. But also in the defense the mine thrower has its definite object, namely, the destruction of hostile mine throwers, the sapping works of the enemy, attacking troops in the hostile trenches and connecting trenches. Especially in trench warfare the mine thrower is incessantly at work to destroy new hostile arrangements for attack or defense.

Since the mine thrower as a rule is hidden in deep cover trenches, the aim must be taken by means of maps and tables the making of which is confided to special units within the mine thrower companies. This work is further assisted by the air service. From these maps the corresponding azimuth and range are deducted. The corresponding elevation and size of charge is found in the shooting tables.

Great difficulties are experienced in supplying the mine thrower companies with ammunition. A great amount of railway cars or other carriages are needed for the transport, as comparatively few mines can be put cn each car. For the transport to the lines sometimes entire columns of soldiers have to be engaged as carriers.

In open warfare these difficulties are still greater, but the reward is so much the greater; in difficult ground the mine thrower is often the only artillery which can be brought forward.

The gas mine is frequently used against troops. Even if the mine does not hit directly, the gas will always spread and penetrate into dugouts and trenches. The direction of the wind is a factor of great moment. In connection with the mine thrower units there are therefore special meteorological stations. These stations send up paper balloons which are observed with field glasses. For this meteorological service fully trained specialists are employed. A careful co-operation between them and the fighting units is necessary in order to utilize favorable weather conditions.

The mine thrower may be called a supplement to the artillery. The invention and development of the mine thrower and the organization of the units for its service have been epoch-making in the history of the art of war.

[Trench Mortars. *Schweiz. Zeitschrift f. Art. u. Genie*, Apr, '18. 1500 words.]

The prime goal of the trench mortar is to demolish obstacles, and particularly to create paths for attacking troops thru the defender's wire. Their latest development dates from the Russo-Japanese War. In that war the heavy artillery was unable to construct for the infantry the necessary paths. This task fell to the pioneers with their wire-cutters and explosives. The difficulty of this method led the Japanese to introduce a weapon on the lines of the ancient catapult and ballista, which would throw explosives into the enemy's wre. The German Army then took up the study of the subject and came to the following conclusions. The minimum effective explosive charge is 50 kg. The trajectory must be curved, to reach covered obstacles. The mortar must be as light as possible for mobility. The mortar should be first used when the troops are so close to the hostile position that their own artillery must cease firing. Mortars with mechanical propulsion proved too heavy and too inaccurate. Consequently mortars with explosive propulsion were adopted. In 1911, for use against permanent fortifications, the pioneer siege train was furnished with heavy trench mortars whose projectiles weighed 100 kg. In 1912 an intermediate mortar, throwing a projectile of half the weight to twice the distance was introduced. Later a light mortar was added principally for use against mobile targets. The number at hand at the beginning of the present war was insufficient for the demands of trench warfare, and consequently use was also made of compressed air mortars, earth mortars, and mortars of mechanical propulsion. Trench mortars firing gas shells were added later, for use against targets which cannot be reached directly. They can be used only when the direction of the wind does not permit the return of the gases to the trenches from which fired. Consequently there is necessary a special weather service, with weather stations where the direction of the wind and the probable constancy of the weather are determined. The trench mortar service requires carefully elaborated charts which must be prepared by special troops from the covered position to provide for indirect laying. The details of the hostile position must be sketched in from aerial photographs.

—Organization

[Artillery Direction Points. *Schweiz. Zeitschrift f. Art. u. Genie,* Mar, '18. 4000 words. (Continued.)]

The consequences of the tactical formula are as follows: leadership must see to it that the matériel is used at the most favorable place and in the best quantity for effect. The potential effect must be taken advantage of to the maximum degree. The technical advantages must be continuously applied according to the demands of the effect principle. It is obvious that the tactical formula must therefore deal with organization and training. We will here discuss some questions of historical development.

The distinction between field, horse, and mountain artillery was a gradual development, There could be no horse artillery until technical skill could provide guns light enough to accompany the cavalry and yet sufficiently effective to be of value. Mountain artillery could not exist as long as armies avoided mountainous terrain. Also, the configuration of mountainous country made a flat trajectory undesirable, and as transportation depended on pack animals, only light pieces could be used. Consequently the superiority of mountain artillery over infantry consisted only in the greater shot effect, the possibility of observation of fire, and the stability of the gun-carriage. In the Russo-Turkish War of 1877-78, the heavily fortified Turkish positions in the Balkan mountains made a heavier caliber desirable. The Austrians devised a gun designed to fulfill

FIELD ARTILLERY—Continued

these requirements. This gun was furnished with a steel shell for effect against permanent fortifications. The increasing use of concrete and of armor led to the desirability of heavier howitzers and mortars, whose introduction became possible when mechanical traction was introduced.

The development of the artillery of the field army has been different. All artillery was at first heavy artillery. Gradually technical skill provided lighter but nevertheless effective guns. The heavy artillery of the field army is a reappearance of an old and forgotten institution. Freytag-Loringhoyen in 1908 invited attention to the fact that Frederick the Great was compelled to use heavy artillery against the Austrian position artillery, and at Leuthen employed 12-pounder fortress guns drawn by farm-horses, which were maneuvered as the infantry advanced. Indeed, the position artillery of these times was regarded as support and reinforcement for the field artillery. It is not due to any fault in the heavy artillery itself, but to an unduly high valuation given to the principle of mobility that the heavy artillery disappeared for a while from field armies.

It is noteworthy here that the modern development of the effect principle in the form of heavy artillery of the field army became possible with the introduction of mechanical traction. When the Russo-Turkish war showed the need of heavy mountain artillery with curved fire, we introduced a mobile 12 cm. mortar and placed it with our position artillery. Our General Staff, however, neglected to study the Austrian motor batteries. A general staff should study the matériel as well as the organization of foreign armies, and particularly the matériel of armies which operate in terrain similar to ours. It is certain that mechanical traction constitutes a vital factor in the development of the effect principle.

Anti-aircraft artillery is a modern specialty. During the Franco-Prussian war an attempt was made to introduce special guns for use against the French free balloons, but without success. Their necessity was in reality first felt during the present war. They are generally used as position rather than as mobile artillery, tho mechanical traction enables them to be readily transported from place to place. In our own case, this specialty was neglected before the war for financial reasons, but had to be hastily installed during the war because of frequent violations of our air-space. Our circumstances did not permit the establishment of aerial service for purposes other than reconnaissance, and consequently we had to turn to anti-aircraft artillery for the defense of our neutrality.

In consequence of the effect principle, high-angle fire guns are recognized as necessary because of the development of earthworks. The development of these guns is made possible by mechanical traction. Tactical views as to their disposition have fluctuated. Three be permanently assigned to tactical units or grouped together in so-called disposition units, whether they should be assigned to the field artillery, and whether they should be mixed in the same batteries with guns with flat trajectory. The first question has been answered in the first sense in Germany and in the second principal questions have arisen: Whether they should in France, the second question has been answered affirmatively in Germany and negatively in France. Losing sight of the peculiarities of our own situation, we blindly followed the German example—and later had to detach our 12 cm. howitzers from the field artillery brigades to distribute them in our field fortifications. The third question is everywhere answered negatively in modern times, tho voices are beginning to be raised again in favor of intermingling guns and howitzers in the same battery. The advantage appears to be inseparable from the disadvantages. The effect principle would gain nothing, and difficulties of training would be increased, especially, as in our own case, where the period of service is short. If they are to be mixed at all, it should be in the mountain batteries, where both classes are needed, while the terrain often prohibits the grouping of a number of separate batteries.

The effect principle has undoubtedly had its greatest advancement thru the construction of rapid-fire guns, since, especially in the case of small calibers, the value of a single shot must be increased by an increase in frequency. This principle was frequently debated in earlier times. In 1890 the Russian General Baumgartner contended that rapid fire was a necessity in ranging fire, as the side which opens the artillery combat frequently was successful; that it was equally necessary in fire for effect, since rapid-fire batteries already in action facilitated the entry of other batteries into the battle; that in general the artillery must fire in short bursts against momentary targets; and that artillery training must aim to develop the utmost accuracy combined with the greatest possible rapidity of fire, since results have to be obtained in minutes of hot fighting separated by hours of inactivity. The opposing contention of Lieut.-Col. von Tscharner (1892) is that effectiveness is lost and ammunition wasted with increased rapidity of fire: that its value is confined to the later stages of the battle and to short ranges; and that in general correct fire distribution and good opportunity for observation are decidedly superior to rapid fire, particularly against wide targets at the longer ranges. The late French general Langlois initiated the thesis that the main objective in the field is the attainment of the greatest effect in the briefest time, the speedy elimination of the enemy by rapid fire of short duration. He advocated a rapid fire gun of small caliber. The French field artillery was the first to adopt an effective rapid fire gun. The effect principle is manifested in the extension of rapid fire to larger calibers.

The evolution of the effect principle is incomplete without reference to the different kinds of projectiles. The technical formula results in our having available shell, shrapnel, bombs, and incendiary projectiles. The tactical formula results in rapid attainment of the maximum effect of these projectiles thru skillful manipulation and good observation. The unity postulate cannot apply fully without loss of effect—it is possible to construct projectiles which combine the characteristics of two kinds, but not of four. (To be continued.)

—Range Finding

[Preparation of Firing Data for Field Batteries. By Capt. Julio Morato. *Memorial de Artillería,* Jan, '18. 2400 words. 4 figures.]

(A mathematical discussion of manner of procuring firing data when the battery commander is not provided with a goniometric glass.)

In this case angles are measured with an instrument resembling the B. C. rule. The sides of angles are marked by points on the ground or by locating men at the vertex and on the sides of the angle.

The range is found by a simple triangulation knowing the angles and one side of a triangle. The length of the original side of the triangle is estimated.

This system is rapid, sufficiently accurate for practical work, and allows the battery to keep its position concealed from the enemy.

On the other hand the disadvantages of this system are the delay necessary between the time the battery gets into position, and the firing of the first round, and the fact that a great many good positions can not be used for emplacements on account of their narrow front.

—Tactics

[Artillery and Aviation. By Capt. Carlos Martínez de Campos. *Mem. de Artillería,* Dec, '17. 25,200 words.]

Phases of the Defensive

An intention to take up the offensive, on the part of an adversary, can only be known by an extraordinary intensification of his artillery fire of all calibers.

Batteries emplaced before the enemy starts his preliminary bombardment will be prepared for all contingencies that may arise. It cannot be told from what point the attack will take place, but all preparations will be made to withstand a push at any point. It is impossible to support the entire trench line with more artillery than the enemy can concentrate at a given point, but the danger of an extensive advance can be eliminated by reinforcing the first trench line, by constructing supporting lines in rear, and by bringing up the heavy artillery. Unless the artillery is organized in such a way that an attack at any point along the front, at any time, can be resisted, the trench system is worthless.

The preliminary bombardment is made with the object of wearing down the defense as much as possible. The length of time that this preliminary fire will last varies directly with the amount of matériel and personnel accumulated by the defense at the point of attack. The longer the preliminary fire lasts the more time the defense can use to prepare itself for the coming shock. From a defensive point of view, all success depends upon a proper utilization of this time.

The primary and strategic object of an attack is to roll back the enemy's line as far as possible, thus destroying the front of assault and to threaten the remainder of the enemy's line; then to continue the attack along interior lines, or to menace positions in rear by moving against either one of the flanks uncovered. A failure to attain either of these strategic advantages is simply a great strategic and material loss for the offense and may result in grave consequences; for the defense, seeing that the offense weakens, can organize an extensive counterattack with every chance of success.

The defense may be either of two systems, different in principle but with the same end in view. The first system is to reply to the offense gun for gun during the entire preliminary bombardment; using all batteries to their maximum capacity, and accumulating such a quantity of guns and munitions that the offense can be entirely smothered.

The second method consists in replying less strongly to the offense, at the same time keeping a powerful reserve of guns and munitions to use at the decisive moment in the conflict. In this case the defense will not attempt to smother the offense until the critical moment of assault. This is a sort of artillery Jiu-Jitsu, whereby the defense expends the minimum of effort to make the offense maintain its greatest fire, and thus wear itself away.

The best way of putting this method into execution would be to have some few batteries, well emplaced, munitioned by rail, to fire over the entire sector of the supposed attack. These batteries will be used to full capacity, and the commander must be prepared to sacrifice them. There will come a moment when these batteries will be put out of action, or will feint this condition by ceasing fire. At this moment the offense will initiate its second phase, which is the real preparation for the attack.

At this moment the efforts of the offense will be directed towards opening a road for its assault waves, and wiping out the opposing infantry. When this phase begins, the defense will open fire with every gun that is available. The fire will be directed against enemy artillery and against the assaulting waves—the latter fire will be in the form of a barrage.

In an attack, the offense will move its heavy artillery as close to the firing line as possible in order to get a maximum effective zone of fire. The defense, on the other hand, is trying to save its heavy artillery, consequently it will be kept well in rear of the front lines.

During the second phase of a modern attack, that is, during the preparation for the advance, the defensive artillery will be concentrated upon all enemy guns most energetically. This is in order to attract the enemy artillery from the objective trenches and thus allow the infantry, in these trenches, to prepare itself for the coming assault.

Heavy artillery must be fought with guns of equal, if not superior, caliber; otherwise the fire will simply be wasted. At Schoorbakke, in August, 1914, the British did not have the heavy artillery to match the German fire. As a result, one company, which moved up to relieve a second one of the same regiment, failed to reach its position and withdrew with only fifteen survivors.

When there is sufficient artillery matériel available, the defense can practice feinting tactics by withdraw-

FIELD ARTILLERY—Continued

ing all troops from its front line trenches, and as soon as these positions are entered by the assaulting troops, a terrific barrage is laid down over them. This barrage can be laid down the moment that the attack barrage lifts to allow attacking infantry to advance.

These tactics will be a surprise to the assaulting infantry, which calculates as the greatest difficulty its advance across no man's land in the face of opposing rifle, grenade, and machine gun fire. This surprise can be greatly increased by a series of powerful counterattacks launched in rapid succession by the defense.

This system has been much used by the Germans, especially in their premeditated retreats, as for example, on the Ancre, on the heights of Le Transloy and Loupart, and in the retreat in the spring of 1917 to the much-discussed Hindenburg line.

After the assault has once occupied the enemy's front lines, its artillery will increase the range and lay down a barrage in front of the new line so as to prevent any counterattacks from coming thru. This barrage is called the "retaining-fire." It is of great importance and special 75 mm. rapid fire batteries should be detailed from the start for this important duty.

In open warfare, the field artillery always increases, its range during an infantry assault so as to bring a heavy fire upon reserves which may be held in rear of a low density; they are everywhere and neverthe- must be taken care of by batteries which earlier in the offensive take part in the preliminary and preparatory bombardments. They will be allowed extra ammunition for this purpose. If the offense has plenty of artillery, special batteries may be detailed to search out and destroy enemy reserves.

Batteries of all calibers, that is, the general artillery mass of a field army, when properly used, is able to delay, or definitely to suspend the initiation of an advance. Once the hostile advance has been initiated the artillery plays the greatest part in stopping it, and throwing the hostile lines back. The artillery action never ceases, either in attack or defense. If not inflicting casualties on the enemy infantry, the artillery is engaged in the still more important work of saving and protecting its own infantry.

This protection of the infantry is given by various calibered cannon. The old light field piece has been replaced by a new type with greater rapidity of fire. This gun was the infantry's great protector. It has now been partially replaced a second time by machine guns, and for the following reasons:

Great range is no longer necessary, as the trench lines and consequently the hostile forces are usually fairly close to each other—always within rifle range. The machine gun can best sweep the zone between hostile trench lines.

Machine guns should not fire unless good targets present themselves. This is the same rule applied to field artillery fire, and has its origin in the need for saving ammunition.

In speaking of field artillery targets, General Percin says: "They disappear one instant and appear somewhere nearer the next. They lengthen out so as to hide themselves along unmasked roads or paths; they cross open spaces rapidly; they only concentrate, or assemble, when under cover; they are movable and of a low density; they are everywhere and nevertheless they are hard to follow."

Naturally targets of this nature can be dealt with more satisfactorily with machine guns than with the 75 mm. field piece.

Furthermore, artillery fire at moving targets, and at disappearing targets, is conducive to great wastes of ammunition.

The garrison of a trench should come out on the surface of the ground in the last period of a defense so as to use their weapons most efficiently. If the defensive artillery opens fire at this time it will be detrimental to its own infantry, whereas the machine gun can be brought into action, rapidly and effectively without endangering the infantry in the least. It is the ideal weapon to be used in this particular case.

The machine gun renders excellent service when the offense advances so rapidly that no counterattacks can be made by the defense. The defense organizes its counterattacks under cover of its own machine gun fire.

An example of the power of machine guns was given at the passage of the Yser in October, 1914. On the 20th of October, after an intense bombardment, a German company gained possession of a ford by a quick and audacious blow. The engineer troops, which were opposing this crossing were all thrown back on account of lack of ammunition. Other German forces crossed the river and gained possession of a bridge head. Under cover of this position many foot bridges were quickly thrown across and the Germans were soon in full possession of the river. The defense was absolutely unable to make any counterattack because the Germans had almost as many machine guns as there were men.

In the passive defense light field pieces will be replaced by machine guns in great numbers. In this case the machine guns are strongly emplaced.

The counterattack consists simply in taking advantage of an intensified artillery fire so as to throw the enemy infantry out of its newly acquired trenches and thus to change from defender to attacker.

Before this war it was said that a passive defense could never bring any positive results. This has not been changed in the least by trench warfare. But once an offensive has started the defense must remain passive until the time arrives for counterattack. The counterattack is an elementary part of trench warfare. The defense remains passive insofar as his positions are concerned.

Counterattacks will be delivered during the two latter stages of a battle, after a rapid and energetic artillery preparation made with the greatest surprise element possible.

If the counterattacks to reconquer lost ground are impossible it will be necessary to fall back, increasing the density of all battle elements, so as to accumulate power and compensate for the weakness resulting from a more extended front, and for the increasing strength of the offense.

Varied Considerations of Artillery Command

Artillery commanders,—those who order as well as those who execute these orders,—are organized for position warfare in the same way that the defensive artillery of a strongly fortified town is organized. In the case of trench warfare the reinforced concrete of permanent forts has been replaced to a great extent by the ground itself; the fort is represented by a sector, the entire position is represented by the length of front, where batteries can be moved about from one place to another with more or less ease.

Each one of these sectors, or great modern forts, has its own artillery commander, and every gun in this sector, from the small trench mortars to the great railway guns, are under his orders. This artillery commander's staff has direct control over every piece of artillery between the two parallel lines which limit the sector.

This artillery commander, chooses positions for emplacements, designates battery or group objectives, and he also decides when the different units will open fire, what intensity of fire they will maintain, when they will cease fire, and when they will take up new positions.

Ammunition supply continues to be the most important problem which the artillery command has to solve. The ammunition problem is always dwelt upon at length in artillery orders.

With the opening of the second phase of a battle the artillery breaks up into two big nuclei, one of which preserves its integrity until the end of the fight, while the other moves out to form a part of the attacking force and breaks up with the infantry. But insofar as the ammunition supply and replacement of casualties are concerned, the artillery commander still retains direction of both nuclei.

The immense fort, which the sector really is, continues to function during the second period much as it did during the first, except that the accompanying artillery, *i. e.,* that which moves out with the infantry attack, passes out of the artillery commander's jurisdiction, and insofar as tactics are concerned comes under the direct and exclusive orders of the general directing the offense.

This officer's object is almost always to break the enemy front. This includes any attempts which may be made simply to rectify the front because in this case he must always foresee the possibility of breaking thru in case the defense is not as strong as anticipated. The forward push must be as strong as possible, and the attacking divisions should always maintain the liaison with their strong points in rear, in the same way and for the same reasons that an attacking battalion always maintains contact or liaison with its reserve or protecting group.

The same relation exists between the artillery and the infantry; a supreme commander of all the batteries, who is in constant contact with the sector commander, and upon separating into two nuclei, a new artillery command which keeps in close touch with the commander of the troops who are moving.

In each case the supreme commander designates the quantity of elements which should accompany the infantry, and the artillery commander designates exactly which elements will move out with the infantry. There may be an organization of artillery before all attacks in which batteries are permanently designated as belonging to one or the other nucleous.

The liaison varies in character with the different periods of the battle.

During the normal activity of a passive defense, and during the first period of an offensive in trench warfare, the high commander preserves contact with the forces under him at all times, being in close touch with regimental commanders of light battery regiments, and with the chiefs of trench batteries, with the group commanders of heavy artillery, and with the battery and gun commanders of the heaviest caliber, isolated guns.

At the moment of advance the high commander loses contact with all forces which have been detached; and with the advance of the light batteries, and the heavy field guns, he is forced to leave his defensive observation station, thereby losing immediate telephonic contact with the heavy guns, and guns of position; or if he elects to remain in his observation station he maintains contact with the latter guns but loses contact with the light batteries and heavy field pieces, which are then forced to establish new lines, which will be used only a short time, or else use messengers at a great expense of personnel.

This latter procedure is the most acceptable, as the batteries should know every moment where their chief can be found.

Nevertheless, there will come a time in the offense when the principal artillery nucleus has demolished the enemy position, and at this moment some of the offensive guns in the rear, especially the high angle fire guns, will have to cease firing because of friendly infantry having entered their effective zone. Contact with these batteries is now useless. With a continued advance, heavy guns will have to change emplacements, and the artillery high command will finally find itself obliged to move forward.

In order then not to lose contact with forces in motion the best thing would be to indicate to them a new central telephone station, as soon as they begin to gain ground. This station will be in turn connected up with the old defensive observation station of the high commander, where he will remain until he orders the heavy calibered guns in rear to cease firing.

Upon moving to this second observation station the artillery chief will establish connections with his old station since the latter must serve as the controlling point for ammunition supply service and as a point of union for the liaison with higher commanders. The lines of communication will increase in length and intermediate stations will have to be established.

Gun Emplacements

In organizing a defensive position the following principle must be kept in mind: When the forces of one trench line attack those opposite, the assault can only be used to take one trench line, a different assault

FIELD ARTILLERY—Continued

wave must be used against each succeeding line.

From this it is seen that the first defensive line should include various parallel trenches at variable distances from each other, at all points at which the defense is to be energetic. These distances between parallel trenches generally do not exceed 300 meters. The number of trenches depends upon the troops garrisoning them, their morale, manner of fighting, etc. Two or three lines is the normal number; in the first Russian advance into Galicia they ran into as many as eight trench lines on a depth of less than one mile.

In construction, the second trench line may be similar to the first but it must be at such a distance from the first line and so built that the preparation for an attack against the first trench line cannot, in any way, be used as a preparation for the occupation of the second and third lines. The offensive artillery must be compelled to move and take up new positions before it can start to work against the second defensive line. The distance between defensive lines must then be rather long, but it is limited by the ever present desire not to surrender ground to the enemy.

At times the first defensive line, or trench group, is reinforced by fixed centers of resistance, which are built around natural obstacles in the terrain, at times armed with artillery of medium caliber. In this case the second defensive line can be at a longer distance from the first line, because these strong points will have to be taken separately, by a series of local battles.

Finally, every defensive line should possess a series of flanking works, armed generally with machine guns and conveniently placed so as to take advantage of the terrain.

The various parallel trenches are connected to each other by an infinite number of communication trenches. All trenches are provided with bomb proof dugouts—in some cases 10 meters and more underground.

The first emplacements that appear in a trench line are the new casemates, cupolas, or machine gun shelters.

The machinery of a defensive line does not enter into action until the last moment of a hostile assault, therefore the works which contain this machinery should be invulnerable, and absolutely hidden from enemy observation.

If invulnerable, they will not be destroyed by the preliminary bombardment; if well hidden the advancing enemy will be unable to avoid coming under the fire of machine guns, whose mission is to continue firing on the advancing columns to the last moment, even at the risk of capture. The machine gun shelter is one of the most important parts of a modern defensive position.

In case earth and lumber are the only materials available for its construction, the machine gun emplacement will usually be 0.6 meter deep, by 2.20 m. wide by 1.80 or 2.00 m. long. Four upright posts are located, one in each corner of this chamber. The posts must be strong enough to support the overhead layers of earth and lumber. These chambers should be high enough to fire over any obstacles in front of the machine gun, but all unnecessary elevation must be carefully avoided as this gives away the position of the work.

Two lateral ditches are usually dug in the interior of the chamber so that the machine gun squad can serve the gun easily. The field of fire should be as large as possible but never less than 90°.

The roof of this little casemate is worked right into the trench parapet so as to hide its position.

Sheet iron and concrete will be used in machine gun shelters when these are built for a determined resistance, or when an excess of visibility must be compensated by increased invulnerability. Machine gun emplacements are often constructed for more than one gun. In this case the fields of fire of the guns should not overlap. The condition sought for is that every inch of the ground be beaten by machine gun fire when the offense launches its assaulting waves of infantry.

Before selecting battery emplacements their relative situation on the battlefield should be considered. The tactical employment of each piece will determine its position.

The theory of an offensive implies advanced emplacements for artillery so it can be effective at a maximum range. This is limited by existing conditions. In the first place the density of artillery is such that it cannot all be placed on a single line, besides, the ammunition columns would clog up the roads, and in case of a withdrawal most of the guns would be captured.

Under normal conditions, heavy pieces of animal or motor traction, less the trench mortars, should be in batteries about 2 kms. behind the first lines; long range heavy artillery about 4 kms. in rear of the front lines, and railroad guns about 6 kms. from the sam lines. All positions should be well camouflaged.

Consequently there will be an ensemble of four lines under normal conditions.

The first line—trench mortars and bomb-throwers.

The second line—cannon from 75 mm. to 120 mm. caliber and howitzers up to 150 mm. caliber.

The third line—all field matériel of over 15 cm. caliber and under 30 cm.

The fourth line—in general cannon of over 24 cm. and mortars or howitzers of more than 35 cm. caliber.

The distribution of pieces within each of the lines will be made with due regard to the terrain, and the maximum flexibilty in case of an advance or a retreat. High angle fire guns will always be in rear of cannon, and the batteries will be placed so as not to interfere with troop movements and supply services.

A battery emplacement should fulfill the following general conditions: Be masked from the hostile artillery fire, protected against its effects and camouflaged against airplane observation.

The problem of remaining masked from hostile artillery fire has been extraordinarily complicated with the use of high angle fire and aerial observation, which banishes all thoughts of protection due to an enemy's ignorance of the range. The high angle fire gun and the long range gun came with the aerial observer, the high angle gun protects itself from the long range

gun by using the natural parapets in the ground; the long range gun protects itself from the mortar by keeping out of the latter's range.

Light batteries, which accompany the infantry, will have to take advantage of whatever shelter is available. They will have no prepared emplacements. A trench may be dug to shelter the gun squad when not firing, and an earth parapet may be thrown up in front of the gun for its protection.

In practice light batteries may have to go without any mask whatever, except the bushes, shrubs or trees which may be on the terrain.

Light matériel, which does not move forward with the infantry, should be masked and casemated the same as the heavy guns. It must be remembered that the minimum depth of dugouts must be 10 meters.

Camouflage is used to a very great extent in hiding all sorts of matériel and personnel. In hiding positions especial care should be taken to avoid any construction that will throw any shadows, as these are easily detected in airplane maps, and by airplane photographs.

Woods are a very good camouflage against aerial observation. The French have used trees and brush to a great extent in camouflaging their short 120 mm. mortars and howitzers. The best camouflage is to bury the batteries deep under the ground, taking care not to disturb or change the surface of the ground in any way.

Emplacements for heavy artillery pieces should conform to all the foregoing conditions, and at the same time difficulties of transportation in case of emergency must be considered. The heavy gun position becomes more and more like a small fort as the war progresses.

Likewise, the number of guns which require fixed emplacements increases with the duration of the war.

Amongst their heavy guns the English have a 35.5 cm. cannon on a railroad mount. This gun goes into action on a newly constructed piece of track, and as soon as it ceases firing the track is removed and carried away. For heavy field guns the caterpillar tractor has been introduced with great success. This auto-tractor seems to have solved the problem of heavy gun transportation.

The one meter and six-tenths meter gauge railroads have come into general use during the war for transporting and munitioning heavy guns. During an offensive, heavy gun ammunition is handled entirely by the railroads. The railroad gun service has become so important that in the French Army there is a special organization of railroad engineers, under the artillery commander, who construct and repair artillery railroad lines.

Target Designation

In this respect the first thing to do is to decide upon the moment when targets will be designated. Theoretically there should be no waiting moments for artillery in modern warfare, but as suitable targets are not always available the artillery is always either firing or waiting to fire. For this reason the dispositions, communications, and training should be such that the battery can open fire in the least possible time. It is with this end in view that pieces are located in permanent emplacements and that for each battery there is designated a fixed zone of fire. The batteries can collect general information on their respective zones, and exact information as to their probable targets.

Artillery fire may be classified as effective and opportune. Effective fire is that which is applied against visible objectives and results in the destruction of these objects. Opportune fire is not at any visible target, and as for destroying any enemy matériel or personnel, it may do nothing, but it will hinder the enemy in some way. The barrage laid down on a trench line with the sole object of keeping the defenders in their dugouts is an example of opportune fire.

The employment of batteries in a "waiting" position—that is, waiting for the enemy to appear, or waiting for probable important targets, is disappearing. This is true because in modern warfare one army knows pretty well just what elements the opposing army has, and their positions. Also, hostile trench lines are generally about 500 meters apart; a dangerous target will always appear somewhere within this 500 meter range, of either trench, and the machine gun is better adapted to handle such a target than the 75 mm. type cannon.

In rare cases targets will appear and advance at long ranges from the trench line. These can only be stopped by the heavy artillery on account of the long range. And the heavy artillery will have had to be in position several hours before opening fire.

The mere fact that a heavy gun battery is emplaced makes it very probable that a target has been designated for this battery before it goes into position.

The most interesting principles concerning target designation are as follows:

A. Each battery should be assigned targets in proportion to its power and type:

In order to gain this end the exact condition of the target must be known. A fire of insufficient strength has no effect and is a total loss; a fire of excess strength is a waste of ammunition and a partial loss. Special matériel has been devised to destroy new targets. For instance, nothing but anti-aerial guns should be used against aircraft, the 75 mm. rapid firing gun should be used against advancing cavalry, machine guns, massed troops under 500 meters range, big nuclei of troops, and for forming barrages, and reducing barbed wire entanglements. Medium calibered guns will be used to destroy entanglements and small calibered guns. Large calibers will be used against medium calibered guns in armored positions, and against large targets at long ranges. Large calibered howitzers are used against the 75 mm. targets when these are masked from direct fire. All mortars and howitzers will be used against targets which are buried underground.

B. The designation of pieces to fire on any target will depend on the effect desired.

There are three effects that can be produced on any target; it can be neutralized, incapacitated, or destroyed.

C. Each line of guns fires on enemy guns which

FIELD ARTILLERY—Continued

are on the same level and neutralizes or destroys those guns nearest.

As the principle in artillery fighting, to destroy one gun with a more powerful one, cannot always be employed, artillery will naturally fire at its nearest targets. The idea should be to fire on those objectives which cannot reply with effective fire.

Seventy-five mm. guns are not sufficiently effective at ranges greater than 5500 meters, but in spite of this, and the fact that they should not be used against aircraft, it seems absolutely necessary that they be able to fire at any angle of elevation between 0° and 75°. This necessity applies to all other guns in the artillery system.

D. The appearance of heavy gun batteries permits the use of small calibered, light guns under more perfect ballistic conditions.

Instead of having to split up all targets between mountain guns and field guns, as was formerly the case, targets can now be assigned to guns which are especially adapted to their destruction. In general, the light artillery will handle targets in the open and moving targets, the heavy artillery will handle those targets for whose destruction it was built, and also, those targets which have been developed to offset it.

Light guns are no longer used against targets of variable depth. The old objectives, which used to demand shrapnel, are now handled entirely by the heavy guns.

The introduction of heavy guns has greatly lessened the number of explosive grenade shells, which were deemed necessary after the Russo-Japanese War and up to the summer of 1914. Heavy artillery has wrested all those targets away from the light artillery against which the latter was impotent. In exchange, the barrage fire has been developed especially for the light calibered guns.

The present system of target designation is based on carefully prepared maps and in all indirect fire a very complete system of map ranging is used. For this purpose and for general artillery use there should be a complete series of large scale, accurate maps, kept constantly up-to-date. New targets will make their appearance and will be located on the map during the course of the operations. There should be a system of conventional signs to indicate all targets.

Special Position Artillery

Trench artillery was invented for the purpose of throwing a heavy charge of high explosive a short distance into the enemy's trench. Trench artillery assists the mortars and howitzers further in rear in their destructive fire, but these pieces depend upon their steel projectiles for effect where the trench mortar relies on its explosive shock.

In using trench artillery the shortness of the range, and consequently, the ease with which the pieces can be reached by hostile artillery, must be kept in mind.

Trench artillery must protect itself by remaining hidden from enemy observers. Trench guns have been mounted on light rails so that they can move away after every round to some new emplacement. The British have made use of a trench artillery silencer, which prevents the enemy from locating the gun by sound ranging.

Before the war the French and English had no modern trench matériel; all their trench artillery was made from the ancient bomb-throwers, mortars, catapults, etc. The Germans, on the other hand, had the following types: The light mortar, 70.5 mm. caliber, which fires a 2 kg. bomb loaded with 1 kg. of explosive, a distance of 350 meters; the medium caliber, 170 mm. gun, which throws a 50 kg. projectile loaded with 15 kg. of explosive over a distance of 750 meters; and the heavy 250 mm. gun which throws a 100 kg. projectile with 50 kgs. of explosive to a range of 420 meters.

The types of trench artillery pieces are constantly changing amongst all the belligerents. At present, the most effective French trench mortar is the 75 mm. Schneider. The English are using three models, one a light 20 cm. mortar firing a 100-lbs. cylindrical-ogival shell loaded with 56 lbs. of ammonal; a second 10 cm. mortar fires a projectile loaded with 2½ kgs. of ammonal, by means of a firing cartridge; a third type fires a spherical shell loaded with from 12 to 15 lbs. of ammonal.

The Germans have two new types of Minenwerfer which fire 50 and 26 kg. respectively of explosive.

In future wars trench artillery will be much simplified and will probably consist of three calibers, capable of firing a maximum of explosive with a minimum of firing charge. Trench mortars will always form a part of the position artillery of the future.

Anti-Aircraft Batteries

Two radically different systems have been employed to fight aircraft in this war, one is the anti-aerial cannon on an automobile mount, the other, an anti-aerial cannon in a fixed emplacement.

Anti-aircraft defense is based on the formation of an impassable barrage, in the air, around the perimeter of the place which is to be protected. This fact makes the anti-aircraft guns on fixed mounts the most effective because the firing data for such guns can be more easily obtained and the fire can be more easily corrected.

At one time during the course of the war it was thought that the anti-aircraft batteries had to travel at a great speed in the same direction as their targets. Seventy-five mm. guns were mounted on powerful high-speed motor cars and were constantly moving around behind the front. This was a highly expensive and almost useless method of combat.

The development of aviation, and especially of the swift chaser type of airplane, has caused the abandonment of all anti-aerial matériel except that mounted on fixed bases. There must be a continuous defense against airplanes, not only around cities, but along the trench lines themselves. The present anti-aerial matériel is such that all airplanes must rise at least 3000 meters before attempting to cross over a trench line. The Germans have located a series of equilateral triangles on the ground with anti-aircraft batteries

located at each angle. These triangles are similarly placed in different series. This formation assures an effective observation of the air, and a dense anti-aircraft barrage that every hostile machine must pass thru before being over enemy country.

The great aim of this war has been to give heavy and light artillery great mobility. In direct contrast the anti-aircraft guns have all tended towards fixed positions and immobility.

The following firing data must be procured in firing against aircraft: The range, the direction in which the target is moving, and the speed at which it is moving. Whenever possible a predicted point should be computed as in coast artillery fire. Special instruments, besides the telegraph and telephone, are used in the fire control system of anti-aircraft batteries.

In the German maneuvers of 1911, Von der Goltz's Army was equipped with the first anti-aerial guns. In the autumn maneuvers of the same year anti-aerial matériel appeared in other countries. In February and March, 1913, German Zeppelins made their first trips to England, and as a result the Vickers plant turned out its first model of a rapid fire anti-aerial cannon on a fixed mount. The coast of Cumberland was later armed with this gun. The French turned out the Déport gun—a 75 mm. rapid firer which could be used as an ordinary field piece, or against aircraft. The English later turned out a very effective 75 mm. anti-aircraft gun. The Germans, in order to increase the muzzle velocity, have mounted a 71 mm. gun on armored cars. This gun fires twenty-five 5 kgs. shells per minutes to an effective range of 6399 meters and with an angle of fire of 75°.

The Austrians reduced the caliber to 37 mm. and made their gun 70 calibers long. This gun fires an .8 kg. shell with a muzzle velocity of 1000 meters per second.

The Krupp and Erhardt works are now turning out a 105 mm. anti-aircraft gun which fires a 14 to 17 kg. shell with a muzzle velocity of about 800 m. per second.

Anti-aircraft defenses increase in strength and density the nearer one gets to the place being defended. That is, a hostile bombing or reconnaissance plane first runs into a light barrage, but as the plane advances on its objective, the barrage increases in density and in destructive power.

[Artillery Direction Points. *Schweiz. Zeitschrift fur Artillerie u. Genie*, Feb, '18. 4300 words. (Continued.)]

That the artillery can only work thru its fire effect; that this is only a means toward the end of supporting the other arms; and that that support can only suffice if the fire effect is increased to the maximum possible—are old lessons of war. There have been two lines of endeavor toward increasing effectiveness of artillery—the technical and the tactical. The former is concerned with the construction of matériel and the regulation of ballistic properties, the latter with the loading and use of the matériel. Both must go hand in hand, or the principle of effect suffers. It is always true that the value of technical matériel must be tested in the light of the morale of the troops and the lessons of warfare. If this test is lost sight of, technical peculiarities are given a higher value than the morale of the personnel. Technical considerations gain the upper hand when the matériel is easy to acquire in time of peace, when it appears imposing, and when long duration of peace has prevented the test of war. Frequently matériel so adopted must be scrapped after war breaks out.

Technical considerations require matériel that (a) can be used tactically on any terrain, (b) is able to annihilate, or at least neutralize, any target which may be presented, and (c) enables one to bring the effect principle into play as early as possible. Consequently we require artillery which not only can maneuver in level terrain, but which can also follow any troops anywhere. In other words, we must have light, horse, and mountain artillery. As to targets, we can distinguish between those which move on the earth or in the sky, and these which are fixed to the ground. To the former class belong troops and aircraft; to the latter fortifications. Either class may be so covered that it cannot be reached by direct fire. The mobile targets may take such disposition that a single shell will have little effect; the fortresses may be so strong as to be immune from destruction by field artillery. It follows that we must have the heavy artillery of the field army, siege and fortress artillery, and anti-aircraft artillery. As to ballistic peculiarities, we must have guns for high-angle fire and, as to projectiles, shell, shrapnel, bombs, and incendiary projectiles. The effect principle has its greatest potency when the rapidity of fire is increased; hence the rapid fire gun. Another requirement is rapidity and certainty of aim. Consequently we must have the best matériel for laying, observation, liaison, and mechanical transport.

The development of these technical principles has been slow. Artillery was at first a guild which surrounded itself with secrecy and mystery. As a result its progress was at first slow, and in some cases it retrograded. Consideration of the fundamental technical requirements would have prevented this. Tactical errors and peace-time theories, diametrically opposed to lessons of war, have added to the confusion. Sometimes lessons of war have been wrongly understood, concomitant circumstances being taken for underlying causes. This is well illustrated by the struggle between effect and mobility, and by the unity postulate.

Every increase of caliber or of initial velocity requires an increase in the weight of gun and projectile. It follows that every increase in effectiveness diminishes mobility. Hence the struggle between effect and mobility. This struggle was not acute at first. For example, Tilly's artillery reached its position in time and took a decisive part in the battle, altho from ten to twenty horses were required to draw a single gun. It could not become acute so long as armies maneuvered on level ground. But when it became necessary to

FIELD ARTILLERY—Continued

maneuver artillery quickly without regard to the terrain, the struggle really commenced. In a sense, Frederick the Great commenced it by instituting horse artillery, whose superior mobility he claimed to have given him the advantage at Reichenbach. On the other hand, Gustavus Adolphus may lay claim to priority, as his mobile artillery (in comparison with that of his opponent) aided him in winning his success at Breitenfeld. His artillery could move around the battlefield; the hostile artillery could not. But the really acute stage came with the substitution of rifled guns for the smooth bores. In general, field artillery in time of peace has striven for greater mobility at the expense of effect, whereas in time of war the tendency has been exactly the reverse. This forgetfulness of war time lessons in time of peace is easy to account for. In time of peace the effect can be observed only against a target; the gun-crews work with undisturbed morale; the effect of hostile fire does not appear; what does impress the onlooker is the swiftness and elegance of maneuver, and the speedy opening of fire—with maneuver cartridges. The situation is very different in war. One loses sight of the elegance of maneuver in face of the brutality of effect. The effort is directed toward damaging our opponent more than he damages us. The moral effect is catastrophal if the enemy's fire outranges ours, as was the case in 1877-78, when the Russians discovered that, in order to produce effect, their guns must fire within range of the Turkish artillery. At Plevna 60 Turkish guns fought four days against 400 field and 20 siege guns of the Russians, and yet were able to take part in the defense against the infantry assault on the fifth day. It follows that during and immediately after a war the tendency is to sacrifice mobility for effect. In the present war, both France and England had to build up a modern heavy artillery.

The unity postulate is the name given to the doctrine which once had vogue, that the artillery should have but one type of gun and but one type of projectile. This idea originated years ago; in fact Napoleon I favored it. Its proponents hoped to thus effect a compromise between the requirements of mobility and of effect. It has always had its opponents, however. One of the strongest of these was Lee, who, while favoring the use of rifled guns at long distance, nevertheless held that such guns could not compare with smooth bores at the decisive moment when the opposing forces were fighting at close quarters. He also believed that the differences in the mode of use of light and of heavy artillery could not be compromised. The question was considerably discussed in the interim between the war of 1866 and that of 1870-71, and again some time after the latter war. After 1871 the principal argument used in favor of the universal type of gun was the difficulty of replenishing ammunition in the field. But that the whole idea was theoretical is shown by the fact that in 1870 this periodical published an article in which it was held that two calibers were necessary, the number of guns of the lighter to be twice the number of the heavier, and that the light artillery should consist of breech-loaders. But in the eighties the change from bronze to steel guns, brought about by the introduction of the 8.4 cm. ring gun, raised the issue again, and we adopted this as the universal gun. One reason why the unity postulate appealed to us was that the short period of service demanded simplification of instruction. The logical consequence of this step was the search for the universal projectile. What was desired was a projectile which could be used against both mobile and immobile targets, and also at short range. Shrapnel with time and percussion fuses was thought to fulfil this requirement. But its effect was not sufficiently great against matériel, and so with the introduction of rapid fire guns there was also added the high explosive shell.

The postulates of mobility and of unity have been detrimental rather than advantageous. They stood in the way of high-angle fire guns, and as a result the Russians were powerless against cover in the war of 1877-78. Nevertheless there were many who attributed the failure of the Russian artillery to the manifold tactical errors committed. The artillery did everything which it ought not to have done. But many critics pointed out that the Russian direct fire guns were powerless against troops in dug-outs.

The failure of the direct fire guns in this war was the starting point of high-angle fire guns in field armies. Nevertheless an effort was made to reach covered targets by means of special projectiles—for example a shell with a time fuse, the idea being that the fragments would have a steep angle of fall and thus strike the trench garrisons. This was all right in theory, but did not work in practice. The effect was produced only when the shell burst immediately above the breastworks, and was never produced if overhead cover existed. The unity postulate had to be given up in favor of the principle of effect. It is interesting to note that the artillery opposed this change strongly, and that it was forced on them by the tacticians.

In our own case in Switzerland, adherence to the postulates of mobility and of unity brought us to a temporary weakness in heavy and high-angle fire guns. Our position at the opening of the present war was painful. France was in the same position. It is questionable whether we could have remedied the defect by a modification of the projectile of our direct fire guns so as to produce a more curved trajectory. In any case the artillery leaders of a country in which there is much mountainous terain, and whose army expects to fight in its own country and in no other, ought to make the ballistics of the trajectory correspond to the profile of the land.

For the future we should take to heart the lesson that the development of artillery armament must depend first of all on the effect principle; it is modified by the requirements of the tactician ad by the capability of the technician.

—Tactics—Co-operation with Infantry

See also
INFANTRY—TACTICS—DEFENSE

—Tactics—Co-operation with Other Arms

[Artillery and Aviation. By Capt. Carlos Martínez de Campos. *Memorial de Artillería*, Nov, '17. 15,000 words.]

Generalities on Fire Tactics

The most important mission of the artillery continues to be the opening up of a breach in the enemy's line so that the infantry can get thru.

In past wars this mission was accomplished in a rather short time. The only difficulty which might delay the artillery was a strongly fortified city or castle which would have to be battered down. However, in open warfare, battles were won more or less automatically, depending upon the superior artillery.

Even in the Russo-Japanese war battles which lasted seven days caused universal wonder.

Wasting the enemy's man power has always been the duty of artillery. If in the present war the Germans had reached Paris in 1914, the world would have been of the opinion that mass formations were the proper formations to use against fortified places, for the episodes of Liége would have formed the doctrine.

At Liége no thought was given to saving the men. The Germans prepared for the infantry advance with their heavy artillery and that bombardment was all the aid the infantry received.

With the advent of trench warfare the life of the soldier became more precious, and artillery was used to save man power. But even then, in every offensive, great casualties were inflicted without any great gain—for example, the German offensive of 1916 on Forts Vaux and Douaumont at Verdun, and the English offensive between Guillemont and Thiepval along the Somme.

In these offensives the artillery bombardment was constantly growing stronger and the infantry assaulting lines growing thinner. The French offensives in Champagne in 1916, at Verdun in 1917, and on the Ancre showed a tendency to increase the artillery preparation. This preparation for the infantry advance is constantly increasing.

The preliminary bombardment is an absolute necessity. As long as the field piece of about 75 mm. caliber was the only one used in connection with an infantry assault it could open a breach in a short time—provided there was enough ammunition and enough guns. With the advent of heavy caliber, long range guns for use in assaults, the 75 mm. gun alone became absolutely inadequate because it could be quickly put out of action by a heavier gun. Heavy guns must oppose heavy guns, and an artillery battle must be fought before the infantry can move.

The artillery battle leads to the organization of artillery masses. The first hint of the artillery mass in modern war was the German regulation of 1908, which provided for battalions of 15 cm. howitzers. These battalions were created to destroy divisional and army corps artillery, which is universally of about the same caliber. Their secondary object—which is very important—is their superior destructive power on infantry.

The aforesaid regulations foresaw and provided for the use of 15 cm. mortars with divisional light artillery against advancing infantry, but did not foresee the possibility of 15 cm. howitzers being used against similar guns, or to assist the corps artillery which may be nearby.

The mission of heavy artillery is that of a reserve to be used when and where necessary. It is not limited to the destruction of enemy works, since many times the German 13, 21, and 28 cm. explosive shells have kept French infantry from advancing. But when heavy artillery is used for the latter purpose it must be under the direct orders of the higher commanders, and they must determine objectives and maintain the liaison between different caliber batteries.

Mass formation in the present decade has not consisted in a concentration of effectives, but in an accumulation of varieties. Especially is this true in artillery, where every sort of mechanism is used to throw a projectile. But the modern mass is divided into a tactical part and a strategical part. The tactical mass is a result of specialization and its size increases in direct ratio with the ranges of modern battle.

The strategic mass is employed on that sector of a front where a political victory is to be won. The strategic mass has a more general character than the tactical mass. An example of the use of the strategic mass was at Verdun.

For the attack of this place the Germans reinforced the two army corps already in position with five other army corps. For two months they prepared for the attack by bringing up extremely heavy artillery—this was the strategic mass.

The fight on this occasion took place on a front of 40 kilometers—much longer than usual, and every type of gun was used along this front. The artillery mass consisted of 2000 guns, whose mission was to prepare for the infantry advance.

The artillery mass has been divided into counter-batteries and batteries for use against infantry. This designation is not correct and in many cases has been the cause for defeat where there were not enough batteries firing on the infantry to stop an advance because the others had been designated as counter-batteries. Some artillerists give a designation based upon the positions which a battery may occupy—watching positions and waiting positions. These positions are always necessary to save man power and the classification may properly result from them. At any rate the classification should not depend upon the target, as the name cannot be given until the target is designated, and all pieces can fire on the three classes of targets—personnel, batteries, and defensive works—in defense as well as offense.

Of course, certain targets are more suitable for one type of gun than for another.

The personnel forms a target particularly suited for shrapnel fire from light field pieces. Heavy explosive shells nevertheless cause great destructive and moral effect. In modern war, attacking infantry exposes itself very little and blends well with the ground.

FIELD ARTILLERY—Continued

It only appears plainly in the last moments of an assault. Hence the need of light quick firers.

The ideal weapon to use against assaulting infantry is the machine gun—and this is the weapon that plays the most important part in an assault.

Fire against hostile batteries is of two kinds, neutralizing fire and destructive fire. Destruction should always be sought for because month after month of shell consumption without result is pure waste. To procure destruction each gun should be fired upon by one of higher power, which, if possible, will be out of the former's range.

Neutralization will be resorted to when there is no time to make proper fire observation, when the battery unmasks itself at the moment of assault, or when the hostile battery is expected to move into a new emplacement.

All calibers can be used for both destruction and neutralization. Economy is maintained in the weight of metal fired. In general neutralizing fire will be used to compensate with steel for lack of time while destructive fire will be used to save ammunition when there is plenty of time.

Defensive works, the third class of targets, are of all sorts. The kind of fire to be used against these is the important point.

The ultimate object is to destroy the personnel or matériel which the defensive works shelter. This is done in two ways. If the works shelter men, the men can either be kept from emerging from their shelter, or be kept from firing. If the works shelter batteries, the shelter may be first destroyed and then the battery, or the battery may be kept from firing. In the methods first described, neutralization is sought after; in the second, destruction.

The caliber to be used against defensive works depends upon the time available for the destruction more than on the strength of the work itself. Of course, a heavier will be more effective than a small caliber gun.

During the artillery duel a piece should not be temporarily silenced—it should be silenced for good and all. The silence of opposing artillery is a great moral aid to attacking infantry.

During the preparation for an attack all batteries will be destructive; during the actual assault they will be neutralizing. This is true for the defense and the offense.

Destructive fire and neutralizing fire are the maximum and minimum limits, respectively, of the artillery's functions—the attrition of the enemy.

Preparation for the Attack

In trench warfare the offensive divides itself into three periods, *viz.*: the preliminary bombardment, the preparation for offense, and the assault. Various calibers are used in each period.

One great difficulty in maintaining a proper offensive is artillery ammunition supply. Railroad lines should be prepared to supply the guns so that no large ammunition dumps should be necessary at the front. Truck transportation should be adequate. The hauling of great quantities of munitions to one place gives the secret away, and it is essential that all knowledge of a contemplated offensive be kept from the mass of the troops and future movements kept as secret as possible. Secrecy is as much a factor in guaranteeing success as it ever was.

Sir Douglas Haig's intense attack on the Ancre in July, 1916, was kept absolutely secret. A feint attack was made by Highland troops north of Arras to mask the real attack, and the preliminary bombardment started on the 28th, the major part of the artillery—especially the heavier pieces—having been moved into position the night before.

When the arrangements for a preliminary bombardment are initiated pieces of large and small caliber are emplaced and are bound to remain emplaced for a greater or less period of time. During this period the batteries collect and keep all sorts of statistics and their maps are filled with valuable information and resemble those of a permanent battery in a fortification. Batteries which are in this condition should be handled as those of a permanent fortification.

Consequently, these batteries can not only be assigned a sector to cover, but the objects to be destroyed during the bombardment can be designated exactly.

In the British attack of Sept 15, 1916, during the battle of the Somme, each battery knew exactly where its objectives were, the order in which they would be attacked, and the length of time to be devoted to each one.

The theoretical mission of the preliminary bombardment is to destroy everything that will hinder the advance of the infantry. This is not possible and the artillery contents itself with firing immense quantities of steel so that the object sought for will be approached as nearly as possible.

The primary object of the preliminary bombardment is to destroy the opposing heavy artillery. The offensive artillery will have to disclose its position to do this, but it is the saving of the offense's light guns. The opposing heavy guns, if not destroyed, can be silenced or made to change emplacements.

Other important objectives for the bombarding artillery are ammunition dumps, bridges and roads that may lead to these dumps, reserve troops.

All these objectives may be conveniently divided up between batteries beforehand, and they will be easily destroyed. However, hidden batteries will appear at the moment of assault. This will require a change of target for some batteries. It is a difficult thing to change objectives with any good destructive results.

In 1870, at St. Privat, when artillery fired from the open on plainly visible targets, the general commanding the first division had great difficulty in making his batteries change targets from the village of St. Privat to the positions which had been previously indicated to them. The increased difficulty of changing targets can be easily seen where the new target is invisible and its presence is known only by the effect of its fire.

The best solution would be to have reserve batteries to care for the new targets, in spite of the increased matériel thus required.

The preparation for the infantry assault constitutes the second stage of trench battles. This preparation should start the moment that the wasting away of the enemy's power appears to have started. The preparation will consist in blotting out everything that may hinder the infantry advance; not simply in destroying trenches, trench mortar positions, machine gun posts, etc., but in burying them under the masses of dirt and stone that compose them.

The intensity of this destruction has increased with the duration of the war, so that now underground shelters are made below the crater depth of the most powerful projectile. The occupants of these dugouts come out at the moment the opposing infantry waves start forward. Absolute destruction of the dugouts cannot be realized but the more guns of various calibers that are used, the nearer is the ideal of destruction reached. A. neutralizing fire will be carried on during the first moments of the infantry advance.

The degree of destruction will vary inversely with the length of front attacked. In a large attack every gun available should be used regardless of its ballistic condition, mechanical condition, or even its antiquity. Guns should be moved from other sections of the front where the pressure is not great. In this way a powerful neutralizing effect will be produced on hostile batteries during the first phase of the battle, and more guns will be ready to take up the work of the second phase.

Artillery is generally arranged in three lines for the work of preparing an infantry assault. The 75 mm. guns are in the first line, guns between 10 and 15 cms. in the second and the heaviest field, siege and position artillery in the third.

In a small attack these lines can be semi-circular. When destruction is aimed at a part of the third line should have the same duties as the other two. In the later stages some of the "counter-batteries," which are medium caliber guns, will change targets to prepare the advance. The light caliber guns will attack machine guns, trench mortars, and artillery near the front line trenches, from the moment the offense starts.

In every case the basis of success in this work of preparation lies in its preliminary organization, in the power and number of pieces, and in a sure and plentiful munition supply. Batteries must fire every moment night and day.

During the preparation for the infantry advance the artillery may be said to have the following tasks:

1. Knock down wire entanglements.
2. Neutralize or destroy the trench defenders.
3. Prevent opposing artillery from going into action.
4. Prevent the reserves from advancing.
5. Destroy machine guns as soon as they open fire.

Taking up each task separately, the entanglements cannot be entirely destroyed. Breaches will be made at short intervals from each other. Isolated 75 mm. guns will fire on the wire rather than entire batteries. The high explosive shell or a special anti-wire shell will be used in preference to any other.

There are two ways of neutralizing or destroying the trench defenders: By the use of an adequate number of high-angle fire guns, with extreme accuracy and a small sector per gun, or by use of a sweeping direct fire from machine guns and 75 mm. cannon.

In the first case the matériel will include all guns and apparatus for firing heavy charges of explosives at a high angle, and will be distributed along the entire front without regard to battery organization. Each piece will have its own objectives and firing data.

The disadvantages of the sweeping fire system are that guns will have to be put into position a long time beforehand, and their assistance in neutralizing the enemy will have to cease with the advance of their own infantry.

Asphyxiating gases may also be used to wipe out the occupants of a trench, or neutralize them. However, this is not a very well-developed method and it is doubtful whether or not gas will be used at all in future wars.

The third mission of the artillery in an offense is, as has been said, to prevent the hostile artillery from coming into action. The hostile artillery on its own side must make every effort to come into action, thus giving its own infantry a chance to come out of their dugouts and repel the assault. The aim of both defensive and offensive artillery will then be to neutralize each other. The attacking artillery will do this by a destructive fire for effect, the defending artillery will do it by using gas shells, thus making it impossible for hostile cannoneers to serve their pieces. The object is to separate the cannoneers from their guns.

As to the artillery's fourth mission, which is to prevent the advance of hostile reserves, it must be kept in mind that troops holding the second and third trench lines do not generally occupy the fire trench itself, but remain under cover during the entire bombardment, manning the fire trench the moment the bombardment stops. For this reason the artillery must increase its range so as to fire on the second and third lines the moment the infantry assaults the first line. Furthermore, a heavy fire must be maintained on the second and third lines until the first line is captured.

The fifth mission is to prevent the terrible destructive powers of machine guns from being brought into action. To do this they must first be discovered. Machine guns are always hidden. Machine gun posts in trenches will be slightly more elevated than the rest of the parapet and may sometimes be distinguished thru this fact. Longitudinal loopholes are generally made to give the machine gun a good field of fire—these may be picked up.

However, the usual machine gun emplacements are so well hidden that they must be found by trying all places where they would naturally be placed, such as salients, the apex of re-entrants, or in the ground in front of the first line trenches—but this last very rarely.

Once located, the machine gun must be destroyed. This has to be done with a weapon that can move out with the assaulting infantry, establish itself in the open under cover of friendly 75 mm. guns, and destroy the machine guns as they make their appearance. This can only be done with a very light field gun that can be hauled forward by the infantry. It must be a rapid firer, very accurate, and able to destroy

FIELD ARTILLERY—Continued

machine guns by direct fire. This gun must not be so powerful that it will draw a hostile artillery fire. In firing it must be moved up at a close range from its target.

These light cannon will not be organized into batteries; each piece will be moved and fired independently so as to obtain the maximum effect in the minimum of time.

Mission of Artillery in the Attack

The infantry must form its assault waves, leave its starting point at the same instant, move forward with a constantly increasing strength in spite of losses, take the first line by superiority of strength, consolidate this position, and then repeat the entire process. The infantry offense cannot perform these tasks without an adequate artillery support, and the giving of this support is the artillery's mission. The various proceedings of the artillery to give this aid constitute the real technique of modern tactics. The tactics of modern war are really a two-arms tactics, since the infantry and artillery are the chief arms. But the term "grand tactics" is more applicable than ever, since strategy no longer intereferes in trench warfare, since the succession of weapons from the rifle to the heaviest cannon, and from the trench mortar to the 42 cm. mortar, is so extended and complicated, and since the liaison between the two arms has become so difficult.

The manner in which artillery should co-operate with infantry is not as clearly exposed as the manner in which the infantry should operate. The details of the infantry attack are communicated to the artillery commanders. These will include the hour at which the attack will take place, the front along which it moves, the depth it will move before sending signals to the artillery, and the points from which succeeding signals will be sent. These orders will be communicated to the artillery subalterns so that they will know minutely how the infantry attack is to be conducted, and will understand exactly the mission of each gun down thru the whole scale of calibers.

Beginning with the small calibered guns, the duty of these guns is to remain as close as possible to the attacking infantry, and thus render the maximum of moral and material support. Many small calibered guns will never leave the front line trenches, but the moment the infantry moves out they will open an intense fire on enemy strong points and machine gun posts.

During the infantry advance new obstacles will make their appearance, which the small cannon must proceed to obliterate. The infantry will have proper signals prearranged so they can send firing data to the small guns.

Light field guns (75 mm.) generally remain in their emplacements. The old rule of having a mobile field artillery, and a fixed or permanent artillery, no longer holds. The mobile artillery, which used to be for emergency use during a battle, has its nearest replica in the extremely light guns we have previously discussed. The light field guns (75 mm.) remain, then, under the sector artillery commander's orders and are used to produce an intensive barrage which will prevent an early offensive reaction. Theoretically the occupied trench should be isolated from the rest of the ground occupied by the enemy, as it would be quickly retaken otherwise. The "contention-fire," or barrage, is the basis of the conservation of new positions. It will stop when the first line is taken and will then be moved forward as soon as the attack on a second position or trench line is initiated.

Seventy-five mm. pieces also follow the infantry advance, but by lengthening their range according to the rapidity with which the infantry companies move. Airplanes with luminous signals will constantly mark the positions of the most advanced infantry waves.

When it is a question of a "meeting engagement," or when the extent of the advance in trench warfare is so great that the principal artillery mass has to move from its first positions, then the groups of light field pieces enter into action as they did in the Russo-Japanese War. The only differences are those necessitated by a greater proportion of artillery to infantry, and by an enormous increase in the number of combatants.

These light field pieces will form a nucleus of strength by which the infantry assault will be pushed over the enemy.

The ideal arrangement would be to have this nucleus consist entirely of 75 mm. guns and smaller calibers, with the proportion of artillery to infantry the very highest possible. If the mobile armament consisted of these 75 mm. guns and lighter ones, they could practically keep up with the infantry in an extended advance. The difficulties of munitioning and moving cannon of any sort over modern battlefields are stupendous. Months of preparation are required to meet the demands of even the most favorable situation.

The stationary batteries, or sector batteries, remain exclusively under the control of an artillery officer and they must handle all enemy batteries or other objectives of importance which are behind the enemy's trench system.

The foregoing shows that the real designation of artillery is the following: Infantry batteries (the 75 mm. and lighter), and artillery or counter-batteries (everything above 75 mm.).

The possibility of a battle exclusively between artillery has been spoken of many times. In this case the infantry advance is a necessary complement. The battle may be determined by artillery superiority, but no ground can be won unless the infantry is present to take possession. The Serbian and Rumanian campaigns were German victories because the German artillery drove out the opposing infantry and enabled the German infantry to move forward and take possession of the land.

Destruction of the enemy's artillery is the only road to victory, but it is far from being the victory itself.

Before the war the object of artillery was to pave the way for the infantry advance. Artillery still has, and always will have, the same object.

—Transport—By Motor

[Note. *Army & Navy Jour.*, Apr 20, '18. 165 words.]

It may now be stated that with the exception of a few batteries equipped with the 3-inch and the 75-millimeter guns, all of the field artillery of the American Expeditionary Forces in France is completely motorized, and horses have been eliminated for that purpose. The change has resulted in considerable saving to the War Department, has proven satisfactory in every respect, has rendered unnecessary the maintenance of large stores of forage and feed, and enabled an increase in the number of effective men for the purpose of handling the pieces. The transportation of horses has at all times been one of the most serious problems connected with the handling of troops overseas and a considerable amount of tonnage heretofore required for this purpose has been made available for troops and munitions. The Quartermaster Corps has now on hand at the remount stations in this country, and available for quick transportation a supply of horses to meet every demand, emergency or otherwise that may arise.

—Use of in European War

See also

EUROPEAN WAR—WESTERN THEATER (Article: "Impressions of a Visit to the German Front in Belgium")

[Italian Artillery in the War. Crónica. *Memorial de Artillería*, Oct. '17. 100 words.]

In the Julian Alps the Italians have assembled 5000 pieces. The Austrians oppose these with 2500 guns, mortars, and howitzers of all calibers. On a front of 6 kilometers 599 cannon fired 91,500 projectiles on the Austrian positions during 14 hours of Aug 18, '17. On this particular day the accuracy of the Italian artillery was very good in spite of the poor vision due to a fog.

FENCING

—Bayonet

See also

BAYONET—INSTRUCTION AND TRAINING

FINANCE, Military

See also

SWITZERLAND—MILITARY POLICY OF (Article: "The Origin of the Swiss Military Exemption Tax")

WAR—COST OF

[Deductions for Clothing and Equipment for War. By Paymaster José R. *Memorial del Ejército de Chile*, Oct. '17. 2200 words.]

The following plan is presented for providing during peace time for the supply, without hardship or inconvenience to the Government, of reserves of clothing and equipment for use during war.

A small amount should be deducted monthly from the pay of each soldier, the fund thus acquired to be expended for the renewal of clothing and all amounts left over to be used in the purchase of equipment.

Ten or fifteen per cent of the ration savings effected in each regiment to be used for the same purposes, care being taken that funds secured be applied for the benefit of the particular regiment from which taken.

FIRE CONTROL

See

FIELD ARTILLERY—FIRE CONTROL

FLAT FOOT

[Brief Studies in Flat Feet. By Lt.-Col. G. H. R. Gosman, M.C., and Lt. H. P. Perry, M.R.C., U.S.A. *Military Surgeon*, Jan, '18. 1800 words. Illustrated.]

This paper is based upon observation and treatment of cases of flat feet at Fort Ethan Allen since Aug 1, 1917. In the 18th Cavalry about 300 men were found with distinct symptoms referable to flat feet. Over 80 per cent of these men were made thoroly efficient within a month. Later men from other regiments were treated with satisfactory results.

In about 2000 men examined at various recruiting stations thruout New England, the writers found some 600 men with some degree of flat foot. About 60 per cent of these were without subjective symptoms and were accepted for enlistment. Symptomless flat foot in civil life leaves the symptomless class within a very short time after admission into the army, with its system of intensive training. Over 50 per cent of the men who have first or second degree flat foot soon become to a greater or less degree inefficient.

About 400 cases have been under observation and treatment at Fort Ethan Allen. Based upon this experience it is believed that the foot imprint gives little idea of the curability of a case. The degree of adduction, of eversion and the degree of immobility of the toes and ankle are the determining factors. It has been concluded that any case of flat foot can be cured and made a useful foot, provided the inflexibility or rigidity is not of such an extreme degree as to render impossible, by proper exercises, a complete development of the muscles essential to the support of the foot bones.

In order that the systematic exercises of the foot muscles may be carried out successfully, the leg should be free from all restraint. Shoes and stockings should be removed. Under-drawers and breeches should be so arranged as in no way to restrict muscular action.

The toe exercises are the first ones taken up. The men are stood on a raised platform, a two-inch plank being sufficient. They are then directed to flex the toes to the extreme point possible with a hard pull of the flexor muscles of the sole of the foot at the extreme point of flexion. This is followed by extension without effort. This exercise is repeated continuously from five to ten minutes, the shorter period at first, gradually lengthening the time as it can be done without fatigue. The second exercise is a continuation of this flexion of the toes on the sole of the foot. At the extreme point of inversion, a strong, hard pull is made, then the foot is allowed to resume its usual position without any muscular effort. At the beginning, fifteen or twenty minutes are sufficient for the entire routine of exercise. Later a full half hour may be devoted to this without marked fatigue. The plan as outlined is carried out each morning. The patients are directed to repeat the performance on retiring, devoting one-half the time consumed in the morning.

Many of the cases with marked inversion or adduc-

FLAT FOOT—Continued

tion of the foot walk with the toes turned out. They are instructed to walk with the toes turned in at all times. This is believed to be vitally important in the general treatment of these cases.

FOKKER AIRPLANE

[New German Fokker, Foreign Service Opinion. *Army & Navy Gazette,* July 13, '18. 200 words.]

According to the *Matin* of June 24, the following are the main features of the new, single-seater chasing biplane, Fokker D7: Total lack of stays; upper and lower planes made of a single piece, whence it has been called a double monoplane; wings of an unusual thickness, with slight curvature on the lower and well marked curvature on the upper surface; a third plane 5 ft. long and 2 ft. 6 in. deep divided by the axle of the landing wheels; camouflage in the shape of hexagonals painted on the canvas; the wings and the landing gear are assembled by bolt and socket joints, a device used in nearly all types of German aircraft. The Fokker D7 is fitted with a Mercédès motor of 160 h.p., water-cooled. The engine is covered by a hood, and the radiator is placed forward in a position to catch the wind. The following are the dimensions of this new double-decker: Maximum space, 10 yds.; length, 8 yds.; weight (empty), 14 cwt.; laden, 18 cwt.; armament, two twin machine guns firing thru the propeller. This machine can climb to 13,000 feet in 25 minutes, and its speed is 125 miles per hour at a height of 7000 feet.

FORAGE

[Oat Substitutes. *Schweiz. Zeitschrift f. Art. u. Genie,* Feb, '18. 1250 words.]

The present war has demonstrated that war preparation is not concerned merely with training and equipping of troops, but also with securing a reserve of food and fodder. Horses are dependent on the oat supply, and the lack of adequate preparation in this respect makes one of two courses necessary: the substitution of mechanical transportation in place of the horses, or the discovery of an adequate supply of some satisfactory subtitute for oats.

Before the war researches along the latter line took the form of tests with barley or with an artificial food preparation known as molasses. Some success was obtained, but all tests demonstrated that time was necessary to accustom the draft animals to the new food. The best results were obtained with barley, which is used almost exclusively in the Turkish army, and to some extent in the French army. The artificial preparation did not meet with success. Under present circumstances the barley supply is, however, insufficient, and further research has become necessary. The same shortage exists to a lesser degree in France.

According to a report to the French Academy of Science, a sea-weed, of the class laminaria, has been found, which, deprived of its salt content, has food-value about equivalent to that of oats. The sea-weed is somewhat deficient in carbohydrates, but has a surplus of nitrogen compounds.

The suitability of this food was tested in the case of six lymphatic horses last July. All six were kept at normal work. Three were fed oats, hay and straw, while the others were fed prepared sea-weed, after one week in which sea-weed was substituted for one-half the oat ration. After twenty-four days the horses fed on sea-weed had gained 6 per cent in weight, the lymphatic ulcers had disappeared, and the general condition was markedly better. The horses fed on oats had not gained in weight. A similar test made with twenty horses by the 1st Cuirassier Regiment, sea-weed being substituted pound for pound for oats, had similar results.

As these sea-weeds exist in masses in all seas, and are easily obtained, it would appear that a satisfactory oat substitute has been found. At any rate the sea-weed can be used for horses not in service, in order to reserve the oats for the army horses.

FORTIFICATIONS

—Field

See also

ENTRENCHMENTS

ENGINEERS—INSTRUCTION AND TRAINING (Article: "Sandbox Instruction, etc.")

EUROPEAN WAR—FORTIFICATIONS, EXPERIENCE WITH

INFANTRY—SPECIAL DUTIES

—Field—Materials and Methods

[The Use of Reinforced Concrete in the Present War. *Memorial de Ingenieros,* June, '17. 2640 words.]

The shelters for soldiers at the beginning of the present war were small holes, lightly covered with branches and dirt. Since then they have undergone a great change. Now they must be suitable for occupation, not only for days and months, but even years. They must not only be capable of resisting cannon and mortars of 12 or 15 centimeters, but they also must be able to withstand enormous pieces of 28, 30, 38 and even 40 and 50 centimeters.

To resist the new artillery it is found necessary to make the roof of the shelters from six to eight meters below the surface of the ground. In order to avoid such vast excavations, the Germans covered the shelters of the troops, and even the pieces of artillery with large masses of reinforced concrete from 1.6 to 2 meters thick. It is evident that these works erected in front of the enemy could not be made in the advance zone of trenches but in the second line. In a battery recently captured by the English, the pieces were placed upon natural terrain, under a mass of reinforced concrete in the shape of a flat arch, making a small tunnel thru which the cannon was fired. It had no heavy covering of dirt. On close examination it appeared that the concrete was made up in blocks some distance to the rear, and then brought up to the battery. No attempt was made to defend the piece from direct fire, but from curved fire only, and the whole was covered with a light layer of earth to hide it from the view of airplanes.

The shelters for the garrisons of the trenches have other forms. They are of necessity more closed. In a trench recently captured by the English from the Hindenburg line, the floor of the shelter was nine meters

below the surface, and the descent to it was made thru two doors.

The thickness of the roofs vary from 1.6 to 2 meters and, according to the German engineers, resist very well projectiles of 21 centimeters.

Not only are engineers used in constructing these works, but even infantry soldiers.

On the Eastern front the Germans have used reinforced concrete extensively, especially in low and swampy ground, where water is met at little depth, preventing deep excavations. A similar type of shelter found on that front consisted in the combination of timber, so abundant in those regions, and reinforced concerete. In one of the shelters constructed near Lemberg, with a roof 1.2 meters thick, it was found that it successfully resisted the shock and explosion of a 21 centimeter projectile.

The French have also progressed much in the construction of shelters. At the beginning of the war they were subject to great privation, and lived in trenches at times almost filled with mud. They had little defense against shells. About November, 1914, they received in the trenches logs two to three meters long, and ten to twenty cm. thick. These were placed a meter apart, covered with boughs and branches, and over all a small covering of earth. Later on receiving large quantities of logs, the latter were placed close together, and in two rows with earth between, giving protection against hand grenades and percussion shells of the field artillery. In the construction of shelters after the offenses of Many and June, 1915, they followed the example of the Germans, constructing shelters capable of resisting the heaviest artillery.

[Suggestions on Trench Construction, Etc. By Capt. H. D. Trounce, Eng. R.C. *Professional Memoirs*, May-June, '18. 7500 words.]

(The author, who was formerly a lieutenant in the Royal Engineers, presents a collection of notes on the construction of trenches, dugouts, mines, bombs, gas, and kindred subjects. The notes are in such condensed form that further condensation is impracticable.)

[Suggestions on Trench Construction, Etc. By Capt. H. D. Trounce, Eng. R. C. *Professional Memoirs*, May-June, '18. 7500 words.]

TRENCHES IN FLANDERS

The majority of the trenches in Flanders are not regular trenches at all. Those of the front line are constructed of sand bag breast-works instead of being cut in the original soil. The communication and support trenches are constructed in the usual manner.

The soil is generally a blue plastic clay; the water level averages from 25 to 30 feet deep; the difficulties of drainage are large, and in underground work it is necessary to keep water pumps constantly going, particularly during the winter season.

TRENCHES FARTHER SOUTH

In Artois and Picardy and in the Somme region, etc., trenches have been mostly cut in the sandy clay top soil. They very everywhere in depth and width. The geological formation of this country is a hard chalk subsoil, with water level 200 feet or more in depth, covered with a top soil of sandy clay which varies in depth from 1 to 2 feet to perhaps 30 feet as a maximum.

COMMUNICATION TRENCHES

Communication trenches vary everywhere, according to soil and other local conditions. In many cases it has been possible properly to revet these communication trenches. The continual demand for men and material to repair, fire, and support trenches, is so exacting that it is impossible properly to revet all communications. In general, it is advisable to put in duckboards, and to allow a width which will permit of single files of infantry or other troops passing each other when relieving, carrying up rations, etc.

Many different types of communication trenches are built elbowed, zig-zagged, etc. The important point is to build them with irregular lines, putting in many bends, so as to confine the effects of shell explosion and decrease the exposure of the men to enfilade fire. Only a general camouflage of ths kind can be attempted. Regular lines should always be avoided. Depths will vary according to distance from the front line trenches and general activity of enemy fire. Some communication trenches are started about waist high, gradually deepening to, in many cases 8 or 10 feet.

Where revetting is absolutely necessary, a uniform system and the same materials should be used where available. Drainage sumps are usually constructed from 10 to 20 feet to the right or left of the communication trench, at intervals of from 20 to 50 yards, and are connected to the main communication trench by deep, narrow trenches, sloped to carry off the water. These sumps should be cleaned out very frequently. Additional sumps can be built in the bottom of communication trenches, say 6 feet deep by 18 inches to 2 feet wide, and 6 to 8 feet long, but these sumps should be avoided where other means of drainage are possible. Care must be exercised in building these trench sumps so that the clay does not slough off too much.

Where the communication trench is dug in chalk, the drainage difficulties will be decreased, but it will be necessary to camouflage the chalk spoil by covering it with clay or other suitable material. Blocking gates are often employed and placed at the junction of communication and support line trenches. Loopholes for rifle fire should control any occasional long length of trench. Overhead splinter-proof should be provided at intervals, particularly at junctions with fire and support trenches.

FIRE TRENCHES

Fire trenches are of varying design—Normal, Block, Tenaille, T's and L's, Occasional Forward, etc. There are many arguments, pro and con, for these different types, but the important consideration is to lay out the fire trenches with the same idea of general camouflage, as obtains in other trenches. Fire trenches being the closest to the enemy will require the greatest of care and judgment in their construction. The enemy cannot be kept from getting the range of them before long, but it is a useful thing so to camouflage them that he will at any rate be guessing as to which is the parapet and which the parados. Fire steps should not

FORTIFICATIONS—Continued

be made any wider or longer than necessary. Drainage sumps should be placed under them. Fire steps should be solidly constructed, and all revetment work in these front line trenches should be very substantial and strong. The parapet line should be irregular. Sentries can make their own niches for firing. The use of angle iron posts and expanded metal was found very satisfactory for general revetment. The expanded metal was wired to the posts and the latter were placed at about 2-foot intervals (see notes on Revetment). Where the trenches were very wet, U-frames were placed at from 4 to 6 foot intervals. These U-frames consisted of posts of 2 by 4 inches, bound with angle iron, with a distance piece a foot from the bottom on which the trench duck-boards rested. This gives a foot above the trench bottom for drainage, and in about every other traverse trench sumps are placed similar to those referred to under "Communication Trenches." The parados should be camouflaged in the same general way as the parapet; and when repairs are made care must be exercised to conceal them from observation as much as possible. Dugout entrances should have the bottom sill of first set a foot above the trench duck-board. This can be done by putting in shorter sets for breaking-out sets.

SUPPORT OR SUPERVISION TRENCHES

It is nearly always possible to put in more careful work on the construction of the support or supervision trenches than on the front line trenches. In general, these trenches are built in the same way. There are, of course, more dugouts here and they are the real headquarters of the infantry holding the trenches. The selection of these trenches is a matter of great importance, and the obtaining of good observation and the best "fields of fire" for machine gun the first consideration. The safeguarding of all telephone wires is important, altho lines are duplicated and in many cases quadruplicated. These wires keep falling under foot as the sides of trenches fall off and must be replaced in a safe position. The absolute necessity of keeping telephone lines intact is so important that men should be constantly warned to pick up fallen wires and report those broken.

Latrines are usually constructed in trenches leading from communication trenches. A narrow bending trench is dug from the main trench and pits 6 or 8 feet deep excavated. Rough frames are built, often with corrugated iron roofs and sides, and these shelters are carefully camouflaged. Large oil or other cans, perforated with holes and placed in the soil, provide simple and effective arrangements for urinals. Chloride of lime and creosol or other disinfectants are used liberally.

DRAINAGE

Drainage is a big problem in the trenches and on the roads in France, on account of heavy rainfall. Many trenches are constructed in the sunken roads. The drainage of the first-class roads is already provided for by the use of deep ditches running on each side. There are, however, many roads where no attempt at drainage has been made; in fact, the existence of culverts seems to be practically unknown. The use of granite paving blocks—"pave"—is very common, and the other good roads are flint or "metalled roads." These roads are, as described, provided with deep ditches for drainage. The other roads give constant trouble, and drainage sumps are excavated at frequent intervals on either side of the road and these connected up with ditches to carry off the water. Where possible, the water should be drained from our trenches into "No Man's Land" or towards the enemy. A little ingenuity will often enable one to divert considerable drainage to the enemy trenches. U-frames, as described, are used in very wet trenches. Drainage sumps are built everywhere; under fire steps, bottom of dugout entrances, and in all trenches as referred to. The British use hand pumps a good deal in pumping off surplus water. These often get out of order and are easily buried and lost in the mud. There is no reason why, at points some way back of the front lines, gasoline or electrical pumps could not be installed to advantage. The water must be kept down, otherwise the sides of the trenches will continue to slough off, and this will cause constant extra work, discomfort and endless troubles. Water collects in large quantities on the sodden, shell-ploughed surface and sometimes percolates thru to the dugouts. The best way to prevent the roof of a dugout in shattered ground from leaking is to fill all shell holes above and gradually develop a slight mound (which will drain) rather than a depression (which will collect water). If, however, the dugout still leaks, then the water should be collected and run into sumps. In chambers this may be accomplished by springing corrugated iron between the girders, allowing a fall to one or other of both walls.

To prevent trench drainage into a dugout, sumps should be cut in the trench at the entrance, not in the galleries at the bottom; tho if the water is already in, soak pits may be made down below to let it drain. This idea would appear to be obvious, but it is often overlooked.

SHELTERS

The enemy build large numbers of either thick steel plate or heavily reinforced concrete shelters and strong points in the trench itself, in addition to their elaborate system of underground galleries. The Allies, however, content themselves mainly with constructing as many deep mined dugouts as are necessary, afterwards connecting these up underground, when possible.

There are many types of shell-proof shelters, description of which you will find in the army texts. One important point in their construction is to limit the thickness of dirt to 9 inches on top of the top bursting course. Where an H. E. shell hits a shelter of this description and penetrates thru several feet of solid earth, the earth naturally serves as additional tamping and causes this result in a much more intensified explosion. A 9-inch top of earth will be sufficient to catch most of the splinters, but on account of its shallowness cannot serve as tamping.

Splinter-proof shelters are very easily constructed of sheets of corrugated iron and sand bags, or of other material available. In all sheltesr, including mined dugouts, it is most important to have the timber of the

structure well braced to withstand shock of explosion. Always play safe, if it is possible to get the material.

As a bursting course, concrete seems to be superior to broken brick or flints, but it should be carried well over the sides of any shelter.

REVETMENT

The general trouble in revetting trenches is that the infantry, and sometimes the engineers, will insist upon building vertical, or nearly vertical, walls or sandbags. The result is that in the course of a few days, and always after heavy rains, the sides will slough off and considerable more work is necessary to rebuild than if they had built the revetment with the proper batter. The head and stretcher method of placing sandbags is the best, being careful to tamp all bags solidly into place and fill in all cavities behind with clay or chalk. A very practical method of construction is to build up this revetment vertical for about 3 or 4 feet in height, and then to build the remainder at a slope of even 25 to 30 degrees from the vertical, placing the sandbags here at right angles to the new slope. Afterwards, if possible, use expanded metal and posts, brushwood, wire netting, timber or other available material to reinforce revetment; but this sandbag method described will usually hold for some time, even if it cannot be reinforced, especially when bags filled with chalk are used.

In hard chalk, revetment is only necessary where sides of trenches have been destroyed by fire. Use stout wire for anchorage, and do not place posts too close to the edge of trench.

CAMOUFLAGE

Camouflage is not the business of a special engineer company, but the work of every man who is wise enough to wish to avoid observation. Portable camouflage is provided, usually in the shape of wire nets, chicken wire, or something of that sort. This wire is threaded with raffia, long grass, brushwood, or suitably painted sandbags or other material. In the trenches, all regular outlines of every description must be avoided. Warm colors look dark and cold colors look light. Roads, railroads, trenches, etc., show up very plainly. It is wise to avoid unnatural shapes which throw shadows. Where canvas is painted, it should be done with irregular lines; should be darker than the surrounding ground and with edges ragged. This subject is covered in some pamphlets and the study of these is recommended.

Pay particular attention to the camouflage of dugout entrances; emplacements of all descriptions, mine shaft heads, junction of communication and other trenches, and all spoil brought to the surface.

With regard to the latter, the spoil is usually placed at night in shell holes, abandoned trenches, behind hedges, in sunken roads, and other places where concealment from horizontal observation is possible. Bear in mind at all times the airplane observation as well as the horizontal observation. The camouflage of regimental camps, etc., is extremely important and must be carefully studied. Study carefully with a strong magnifying glass the airplane photographs covering your sector of the front. You will notice from week to week little changes in the enemy's lines, which with careful study, will furnish you with important and useful information. In general camouflage should seek to retain or copy pre-existing conditions to avoid changes which will be revealed by later photographs.

TRANSPORT

Every unit has its own transport. All tools, machinery, building material, rations, ammunitions and supplies, etc., are brought up after dark in the trucks and wagons of the regimental transport. In most cases they are driven as far as the advanced material billet or rendezvous. These advance billets are commonly situated about three-fourths of a mile to a mile from the firing line trenches. Here everything is taken on to the forward trenches by carrying parties detailed for the work. It is also common practice for the Infantry working parties assisting engineer units to be met at this point by guides from the engineers, and the latter, after the carrying and working parties have loaded themselves with the material and tools to go up, march up the trenches to the different places where the work is progressing. Reliable guides should be detailed; one usually leading, and the other following the working party, to see that they arrive without unnecessary delay and with the correct timber, etc. Infantry working parties have a happy faculty of losing themselves very easily. All officers, drivers, etc., must study very carefully the maps of their area provided for them, and must be able to find their way around confidential by night and day. During the winters, the British found it necessary to establish "road control," or a system of detailing the various types of transports to travel by special routes, in order to allow opportunity for properly repairing the more commonly traveled and direct roads.

EMPLACEMENTS FOR STRONG POINTS

These include emplacements for trench mortars, machine guns, snipers posts, artillery observation posts, etc. It is necessary and advisable to change the position or emplacement of the heavier machine guns from time to time; in consequence, their emplacements are mainly earth platforms, and they are usually located by M. G. officers and built by their own crews. There are, however, some machine guns which occupy secret emplacements. These guns are only used in cases of emergency, and the construction of these positions is more elaborate than the others. Trench mortar emplacements are also quite sample, usually pits excavated in the soil, from 8 to 10 feet square and 6 to 8 feet deep. Mined dugouts are always located very close to machine gun and trench mortar positions.

Snipers' posts should be constructed with the utmost care and only used by the snipers themselves. As a rule, it is advisable to leave their construction to the infantry, altho engineers build them when requested according to their design and requirements.

Specially constructed observation posts for artillery and infantry are not common; advantage being taken of various positions suitable for observation already existing in most trenches.

DISPOSAL OF SPOIL

All spoil handled in sandbags, and brought out during

FORTIFICATIONS—Continued

the day is either used in the revetment or repair of existing trenches, or else stored in what are termed "daylight dumps"; at night these sandbags, filled with clay or chalk, are moved from the "daylight dump" and spread around on the top of trenches in shell holes and abandoned trenches, etc. Where men are working at night in "No Man's Land," or any point within range of enemy machine gun or rifle fire, it is wise to warn them as to their conduct when the enemy's star "Very" lights go up. The "Very" light is a white rocket, usually bursting high in the air and breaking into a number of white stars which light up the ground all around within a radius of, perhaps, 100 yards in every direction. When these lights burst close, every man should either stand still or drop flat. In the event of the light going beyond or behind a party, it naturally throws their figure into relief, and in this event they should drop at once. Under ordinary circumstances, it is quite sufficient if they stand or keep still. This is important. Naturally, an officer will try to arrange his men on top so that they are exposed as little as possible. It is always necessary to see that the infantry working parties dispose of all dirt properly, and in addition camouflage all spoil. This requires constant supervision on the part of the officer. Do not allow engineers or infantry working parties to throw the sandbags from the trench upon the top of the parapet or parados. Make them place all bags by getting on top themselves, naturally at night, and either empty the contents or place the bags in shell holes, etc., or build up the trench by a proper trench revetment system. At every opportunity, they will, unless watched, be anxious to get rid of them, and throw them up anyhow, and this will surely result first, in your work being noticed by the enemy and consequently "strafed" very shortly, and secondly, in your trenches being built up to a height of 10 or more feet, with great danger of the whole trench falling in and burying sentries when mines are exploded in the vicinity. Do not fill bags more than three-quarters full. Split up your working party according to the number of jobs you have on hand, and detail, if possible, one of your own N. C. O.'s in charge of each group. An infantry officer always accompanies a working party, and you will find him of assistance, but you are in charge of and responsible for the work, as well as the safety of your men. See that your own parties and the infantry working parties come into the trenches in small sections and that proper care is exercised in taking all cover available. Warn them not to show their rifles, or any of the timber, or tools, over the parapet whilst they are carrying them up. They should make no noise in coming in, and should only talk in low tones as necessity demands when working on top close to the enemy. The latter may be occupying a forward listening post near them and open fire on the whole party. No smoking can be allowed during work on top. Keep in touch with the officers of infantry holding the line and inform them of the location of your night working parties.

Warn your men about lingering in trenches which are found to be exposed to enfilade fire from enemy, and at points such as the conjunction of communication trenches, with firing and support lines. These are favorite targets for the enemy. "Stand To," or "Stand To Arms" with the infantry always takes place one hour before daylight and one hour before dusk.

MINED DUGOUT CONSTRUCTION

The following methods are the result of considerable practical experience. They are not the only ones, but selected as being the most widely adaptable; many modifications, suited to varying conditions, are possible.

1. *Standardization.* It is recognized that a considerable saving of timber, labor and time can be effected by the standardization of dugouts. The following standards are suggested:

A. Bunks to be 6 ft. 6 in. by 2 ft.

B. Minimum inside width of chambers, with rows of bunks on each side, 7 ft.

C. Minimum height of galleries or chambers, in the clear, 6 ft.

D. Minimum width of entrance, 2 ft. 9 in.

E. Entrance frames, 5 ft. by 2 ft. 9 in. (for use in entrances in which the frames are set at right angles to the dip).

F. Use of standard case for gallery (3 in. or 4 in. casing, 6 ft. by 4 ft. inside dimensions).

2. Cover. Cover depends largely on the class of ground. Tunnel dugouts must be sufficiently deep below the surface to compensate for a lack of bursting course. When building dugouts in the winter season and where the surface has been liberally pitted with shell holes it will be wise to go deeper and adopt precautions to insure the drainage being properly taken care of at the outset. The following may be considered minimum cover under such circumstances:

For chalk, 25 feet.

For clay, sand or earth, 30 feet.

In chalk a considerable saving in timber can often be effected by going 10 feet or 12 feet deeper for a start.

3. *Location.* Location of these dugouts will be determined by consultation with the infantry, artillery, or other units who propose to occupy them, should usually be constructed in groups, each dugout of a group being joined to the other.

4. *Nature of Timber Joints.* Some objection is raised to the use of the mortise-and-tenon joint, and solid-butt joints with spreaders have been suggested as an alternative. General experience, however, has shown that the use of the mortise-and-tenon joint, as standardized in German dugout construction, allowing for wooden wedges at the joints, is the better practice. German underground work is almost invariably close timbered. Cases of 4-inch oak or hardwood, using from 9 by 4 inch to 12 by 4 inch timber, is generally employed. Galleries 6 by 4 feet (inside dimensions), are found everywhere in their lines, and the sets are usually braced by wedges at the joints, one being driven in the bottom sill of one set, and the next in the top sill of the succeeding, and so on.

5. *Earth Pillars.* For pillars of solid earth between chambers nothing less than 10 feet should be considered, even in the most solid chalk; in clay still larger

pillars should be left. Timbering naturally varies with different designs. Chalk weathers very rapidly in dugout chambers, and should be protected in some way by lagging, expanded metal, corrugated iron, etc. The use of wire netting packed behind with straw is useful, but has the disadvantage of harboring vermin.

6. *Entrances..* Nearly all dugouts have two or more entrances, and these are usually built in from the bottom of the trench at an angle of 45 degrees. They should be well concealed and have not less than 5 feet of head cover, with bursting course, if possible. A good plan is to strut the trench well opposite the entrance. The entrance to a dressing station dugout should have an incline of 30 degrees.

Stepping down in the trench is recommended in starting entrances if additional sumps are provided to take care of drainage.

Entrances should be close timbered, even in chalk, for a distance, of at least 15 feet and preferably the entire slope. Many designs for entrances are given in the texts. If the entrance is started directly from the bottom of the trench, with little head cover available, double breaking-out sets should be put in. These breaking-out sets will usually be short in order to obtain adequate cover. After the initial sets have been placed it is the best plan to place the sets at right angles to the dip. A combined bomb trap and sump can be placed at the bottom of entrance, if necessary, and partially timbered over. The sill of the first entrance set should be at least 12 inches above the duckboard of the trench. The necessity of bracing timber very carefully is emphasized and of using spreaders and stringers to reinforce. Nothing less than 3-inch timbers should be used for entrances. It must be remembered that the shock of a bursting H. E. shell is almost vertically downwards, and that sets are liable to collapse in the direction of the dip unless securely supported. For this reason, entrances should be close timbered to a depth of absolute safety, so that the sets below will prevent those affected above by the shock from collapsing. Do not attempt to dig a hole for four or five sets to be timbered later; it endangers the lives of those working, and if the face or sides begin to "run," involves an immense amount of labor and leaves an entrance weak and unsatisfactory, which will give constant trouble later. As a guide, when excavating for entrances timbered at right angles to the dip a template in the shape of a 45-degree triangle with about 2-foot sides and a plumb-bob should be provided. The use of 2- by ⅝-inch straps, spiked about 6 or 8 inches from the top and bottom of the sides is recommended. Failing this, 1 by 4 inch boarding can be used. Steps or ladders for this type of entrance made of ½ to 2 inch lumber are put in afterwards. These steps are made up usually in 6-foot sections and nailed in place. The average progress per shift of 8 hours should be about 4 or 5 frames set, and the class of ground, whether clay, soil or chalk, should make little difference. When changing direction from 45 degrees entrance with average sets (5 by 2 feet 9 inches), set at right angles to the dip, to a level gallery of 6-foot head room, one special set is required together with some specially cut lagging boards. This construction is similar to that of the breaking-out sets.

7. *Galleries.* Spilling. (Supporting the roof at the head of excavation.) In loose, heavy ground, this is the only method to adopt, for comparatively shallow work down to 25 or 30 feet. It is always the best Advantages:

(*a*) Roof is kept as solid as possible and bears evenly on the timber.

(*b*) Men working are in no danger from falls of roof.

(c) In shattered ground it prevents the face "running," which if once started means considerable trouble, and results in reducing the cover over dugout.

The waling board is of 3- by 3-inch timber, and rests on distance pieces, placed on top of the cap piece of the ordinary frame. The distance pieces must be large enough to allow the spilling boards (*i.e.*, overhead lagging) to be driven forward by hammering between the waling board and the top sill.

The spilling boards are maintained at the original angle by using a spare cap as a distance piece, bearing on lagging or spilling boards of the set behind.

Sometimes, in very heavy ground, the spilling boards bend with the weight before they can be driven home; in this case, intermediate temporary sets are used. The forward one supports the end of spilling boards, while the back one serves as a distance piece to maintain the angle of drive. The boards are driven from underneath the cap.

This method, of course, necessitates the excavation of the ground between sets in two distinct operations, first to place the intermediate set, then to place the permanent set.

In any case, as soon as the weight begins to come on the back, lagging boards will rest on the waling board of the forward set, and this in turn on the lagging, so that the whole becomes absolutely tight.

Spilling boards should be at least 1 foot longer than the span between sets.

When spilling in chalk it is often necessary to pick out the ground ahead of the spilling boards in order to facilitate driving; in this case only pick out enough to allow one board to be driven at a time.

8. *Chambers.* In almost all ground an 8-foot span is too great to stand without intermediate props, but there is no need to place the intermediate prop in the center of the girder. When it is intended to bunk the chamber later, the intermediate props may be set leaving a space of 2 feet from the wall prop, alternately first on one side and then on the other, thus giving a maximum span of girder of approximately 5 feet 6 inches, which is sufficiently strong for almost any ground.

It is always advisable to avoid notching props (the process only weakens them).

To prevent the props from pushing inwards when side pressure begins to come on, it is advisable to shrink on clips or brackets, but old horseshoes, or, in fact, all kinds of scraps have been used. Brackets and clips are commonly made by units and differ considerably in strength and pattern.

FORTIFICATIONS—Continued

Spacing of girders. The general rules are:
In clay, sand or soil, 1 ft. 6 in. centers;
In chalk, 2 ft centers.

After the girders are set, it is necessary to strut them to prevent them from rolling over or pushing out sideways. The method usually employed is to wedge struts of 4 by 3 inch timber between one girder and the next. Four such struts are used, one at either end, and two spaced 3 feet apart from the intervening length of girder. Care should be taken to wedge these in extremely tight.

When chambering in clay, sand, or soil, it is necessary to provide foot blocks about 12 by 12 by 3 inch for each pit prop. In chalk this is not necessary. Props should be cut 3 inches longer and let into the floor 3 inches. In case of clay, sand and soil, the foot block is left below this again, but the weight of the roof will generally press it down the extra 3 inches.

Spilling. Little need be added to remarks on spilling in connection with galleries, but this safe method of working cannot be insisted on too strongly. When driving chambers the intermediate sets are replaced by intermediate girders supported by pit props, or by using ordinary cap pieces of gallery frames supported by pit props, just to hold up the spilling boards prior to setting the forward girder.

9. *General.* In figuring on carrying parties, you can estimate one man to carry 100 bags along 100 feet of gallery per 8-hour shift, and one man can carry 100 bags up 10 feet of entrance per 8-hour shift. These figures will apply to gallery and chamber work. In almost all trenches taken over, it will be found that there are a number of dugouts already built, and in addition to building more it will be necessary to inspect and probably repair a number of these old ones. Make the design of dugouts as practical as possible, having in mind the materials which can be used in your area. Always figure three to four times the strength necessary to support merely the load, due to the thickness of roof entrances. Where necessary, a hole can be drilled thru the roof of the dugout to provide additional ventilation, and may be used for a periscope. It is also desirable to construct an alternative or emergency exit behind the parados to a surprise position for machine gun. Each dugout should be connected by speaking tube to a sentry post. The latter should be given as much protection as possible. Two picks and 2 shovels should always be kept in each dugout for emergency. Frames of standard dimensions will doubtless be supplied from engineer trains. Timber is very seldom framed on the spot.

Wire Entanglements. This subject is taken up in detail in the military texts and pamphlets. The infantry make up and place many of the entanglements. As a general thing, the wire entanglements in front of the fire trenches are not as thick and wide as they are between the front and support line. Wire entanglements for "No Man's Land" are made up back of the line, or in the trench, carried out and placed in position at night, most of the work being done beforehand in the trenches. Wooden posts should not be used in "No Man's Land." It is not a healthy practice. Angle-iron knife-rest entanglements are very practical for use here, and the cork-screw, pointed, or other iron posts are also useful. When out laying wire at night, do not fail to notify the infantry officers occupying the trenches as to the time and place you propose working, otherwise you are likely to be taken for a hostile working party and have your crew blotted out.

RETREAT OF ENEMY

Enemy's Destruction. In a planned retreat, the enemy will do all the mischief they possibly can and destroy everything which may shelter or be of possible advantage to the pursuing forces, in addition to impeding pursuit with many obstacles.

In the retreat of Arras, the following conditions were encountered: The enemy had leveled all houses, walls, and buildings of any description, seldom leaving any wall of a height more than 3 feet. Nearly all the houses and buildings in this area are built of hard chalk blocks with brick foundations. They blew in all the cellars and destroyed entrances to all shelters, dugouts, and chalk caverns. Most of the wells were destroyed; others they attempted unsuccessfully to poison with chemicals. All trees were cut down to within a foot or 18 inches of the ground, this work having evidently been done with gasoline saws. Trees, many of them of large diameter, were felled across the road to impede traffic, also across streams and rivers. All bridges were destroyed. The rivers are not wide in this district. At practically every crossroad and at quarter-mile intervals on the roads, mine craters were blown, varying in size from 60 to 70 feet in diameter to 200 feet or more, the depth of these craters verying from 20 to 50 feet. Many dugouts, galleries, and shelters were destroyed by fire.

Delayed and Contact Mines and Bomb Traps. Numerous devices were employed for mines and bomb traps. Railroads were undermined with large charges of high explosives, and the first trains going over after the evacuation were destroyed. Contact land mines were placed at crossroads, which would be fired by heavy vehicles crossing them. A large number of dugouts were mined. The charge, as a rule, was placed half way down the dugout entrance on the right or left side. It was usually observed that the timber or casing was slightly disturbed, but to detect these changes it required a sharp eye. The charge was connected by leads to one of the dugout entrance steps, so that it was fired as a man walked down to the dugout. These charges were tamped with sand bags. Many delay-action mines were left in the large dugouts or headquarters; several brigade headquarters went up after they had been occupied by the British for ten or more days. Numerous bomb traps were found. The German "hair brush" bomb would be tied by means of its fuse cord to a loop of wire; soldiers would catch their feet in these loops and so fire the bomb. The "egg" bomb was fastened in many other instances underneath the trench duckboards; stepping on these would explode them. Many souvenirs, helmets, etc., would be hung on nails in dugouts, and these would be attached to bombs which would explode on making an attempt to remove them.

General. Much ammunition, high explosives, timber of all descriptions, and many other stores were left behind the enemy in districts where the retreat had evidently been more hurried. They had destroyed, or partially destroyed, nearly all of their reinforced concrete shelters and steel plate observation posts, etc.

The bulk of the above demolitions were carried out by the use of German high explosives, Westfalia and Perdit, etc. Many caches of the latter explosive were found, some in large quantities. These high explosives used were similar to ammonal and were easily detonated by us with primers of dry gun cotton and blasting caps. As many engineer and other units as could be spared were immediately put on to road repair and road construction work. Where the roads ran thru the old trenches, it was found necessary to take the timber from the nearest German dugouts and corduroy them. Plenty of brick was used where no other material was readily available and was of undoubted temporary value. Later it was replaced with road metal.

Conclusion. It would appear to be wise to go very carefully in following up the enemy on any retreat, especially a planned one. Evidence of planned retreats in trench warfare is not difficult to obtain. For a week or more before the retreat, many fires are observed in enemy lines and villages; numerous small and large explosions are heard everywhere, and much valuable information secured by the Air Service. Numerous delay and contact mines and bomb traps of all descriptions can be looked for in his lines everywhere, and considerable caution must be exercised in withdrawing them. It is essential that road building material be available in large quantities close up to the lines in order to insure rapid pursuit, and enable the artillery to be brought up as fast as possible. An efficient "road control" should be immediately established and one-way and double-way traffic routes arranged. In addition to the road and other work, engineers are required to investigate and withdraw all mines laid and pick up all bomb traps, etc. Later, after a preliminary reconnaissance has been made, the salvage of immense amornts of dugout timber, steel plate, and other material and stores left behind by the enemy is effected by the engineers and used later to good advantage.

Traffic must be kept moving as fast as possible, and when tie-ups ocur by trucks being ditched or broken down, every effort must be made to repair quickly or remove them from road somehow. Enemy planes or artillery immediately take advantage of these situations to make things unpleasant. Some useful road material is often secured by blowing up carefully some of the enemy's concrete posts.

BOMBING

The enemy does not stop to inquire as he comes over your parapet as to whether you are an infantryman or an engineer, so it is neessary that every engineer on "first line" work be well able to take care of himself, and in this regard the use of hand bombs or grenades is very effetive. Training in bombing and in the construction and use of our bombs as well as of those of the French, British, and enemy will be given you later. Study particularly the manner of throwing the commoner varieties of enemy bombs. At present it is only necessary to say that the calmness and confidence developed from the use of bombs will stand you in good stead in emergencies. The universal bomb (Mills) used by the British has been found very successful and almost "fool-proof," and our grenades will have similar safety features. A little care at the outset when training in the use of bombs will save casualties; many accidental casualties occur in bombing practice on account of either "jumpiness" or recklessness. It is advisable also for engineers if possible to learn something of the construction and use of machine guns. In modern trench warfare the engineer is often called upon to defend himself and he must be familiar with all weapons and practiced in their use. Needless to say, he should be a first-class rifleman. The British Engineer Units always carry their rifles with them into the trenches. Observe the location of bomb boxes or stores in the advanced trenches. In making their rounds of inspection in these trenches at night, officers are recommended to carry a couple of bombs in their pockets.

GAS ALARMS

The surface gases encountered are chlorine, phosgene and bromine. These gases are all heavier than air and are released under high pressure from steel cylinders in the enemy trenches. The gases roll over in big clouds at velocities varying from 5 to 15 miles per hour according to the wind. In an average nine mile wind the gas would reach trenches 100 yards distant in 20 seconds.

The use of gas appears to be growing less, as it is essential that the wind be exactly in the right direction and the wind velocity also favorable. If the wind happens to shift at the last minute, naturally all of your own men may be gassed.

Preliminary drill and training in the use of gas helmets is absolutely necessary, and men are passed thru these gas drills until they can put on their helmets in, at the most, 5 seconds. At the base camps, every officer and man reporting will doubtless have to go thru a gas chamber to test his confidence in the helmets. Once one has this confidence in the use of a gas helmet, very little fear is felt as to gas attacks. Gas helmets are issued and carried by all troops operating within 3 or 4 miles of the front lines and must be carried by every one whether in the trenches or in camps behind the line. It is usual for each man to have a second helmet in case of loss or injury to the first.

Gas alarm signals are arranged by having at frequent intervals in the trenches and at all villages within 3 or 4 miles of the line notice boards with notices "Gas Alert On" or "Gas Alert Off" on them. When the "Gas Alert On" signal is shown, all troops in the front trenches carry their gas helmets at the alert position on the breast so as to be easily available for immediate use. When the signal "Gas Alert Off" appears, the gas helmet is carried in the usual way, hung over the left shoulder.

In addition to these notices, there are signal horns, much like powerful automobile horns, and gongs composed of shell cases with a striker attached, by means of which the alarm is immediately sounded. If a gas

FORTIFICATIONS—Continued

attack should occur on your sector, the only thing to do is to take it quietly. Pull your gas helmet over your head as fast as you can, and proceed to "stand by" to man the parapet in case of infantry attacks following the gas. You will, of course, see that all of your men put on their gas helmets at once. Warn every one not to hurry over anything and not to exercise more than is necessary, in fact, to do nothing which will quicken the heart's action.

Officers will order gas drills frequently and make careful inspection of the gas helmets carried by their men. The enemy sends over gas in a variety of ways; one of the commonest methods is to send it over in gas shells. The German 5.9-inch shell, holding about 7 litres of a gas producing liquid seems to be the best medium for transmission. These gas shells do not burst with the usual loud report, but fall and burst like a dropped melon, releasing the poisonous gas.

The lachrymatory or "tear" shells are used constantly, but this gas only affects the eyes, and does not do material harm. Sponge goggles are provided to cope with it. It is mainly designed to use against gunners.

The asphyxiating and suffocating gases are far more severe in their action. Sprayers are provided in the trenches for spraying the blankets of gas-proof dugouts and shelters, and for neutralizing effects of gas in dugouts.

When the British put over gas attacks, it is their practice to leave only the gas men and the Lewis gunners in their front lines. Engineers are warned by the Brigade Staff to withdraw their men at each of these attempts.

—Field—Use of in European War

[Trench Warfare. By J. M. M. *Mem. de Ingenieros,* Aug, '17. 5280 words.]

The present war is one of position. The front may be compared to a vast factory which contains every class of machine, each machine and each operator having a definite task to perform.

The front proper is formed of numerous lines of continuous trenches, redoubts, fortified villages and woods places in state of defense, all connected with lines of communication; the whole forming an enormous system of earthworks, which may extend, in a direction perpendicular to the front, for a distance of ten kilometers. This complex system of trenches is divided into three zones, the organization of which varies with their mission. These zones are: the zone of combat, zone of defense works and zone of rest.

The most advanced elements of the first zone are oftentimes as close as forty meters to the enemy; not more distant in general than two hundred meters. This zone consists, first of a series of listening posts which are occupied only at night and connected by tunnels to the trenches in the rear. This trench in the rear, on account of its close proximity to the enemy, cannot have large earthworks or overhead shelter. As it is exposed to any sudden fire of the enemy and apt to be taken, it is necessary to duplicate this trench by a similar one from 30 to 60 meters to the rear, which serves as an assembling point, enabling the defenders to retake the first trench. As in the first line, the close proximity to the enemy prevents the construction of extensive earthworks.

Secondly, the line of support, which consists of a double line of trenches constructed from 100 to 200 meters to the rear of the advanced positions. These trenches offer greater protection to their occupants and serve as resting points for the occupants of the first line. In case the first line is taken these lines will offer a stronger resistance to the enemy.

Thirdly, to the above line of resistance is added, in some sectors of the front, a second line of duplicate trenches from 1000 to 2000 meters to the rear.

The first zone consists not only of the above simple or double line of trenches but also of points of resistance, strongly constructed in villages, woods, heights and so forth, well provided with artillery and machine guns, and capable of delivering fire in any direction. These centers of resistance are for the purpose of stopping the enemy when they have taken possession of the first line, and, by means of enfilade fire, compel him to dig in before continuing the advance.

Details of Organization of the First Zone

The location of the trace of the trenches, to-day as before, is still a matter of judgment. A trench in rear of the crest of the hill is screened from view and protected from direct artillery fire, but it has a limited field of fire. With the present airplane reconnaissance, the use of high angle fire and an almost unlimited supply of ammunition render trenches located in rear of the crest almost as vulnerable as those to the front. A few machine guns well protected from this artillery fire and used only to repel an assault will cause an enormous loss and favor the success of counterattacks.

In order to limit the effects from artillery fire, both oblique and enfilade, and even from hand grenades and areial torpedoes, the trace of the trenches is sinuous with numerous traverses.

The profile of the trenches has changed but little in form. They are deeper and narrower, to give greater protection, with fire steps and loop holes of wood and sand bags. To watch the movements of the enemy, periscopes are employed at the most advanced points. The dimensions and perfection of these works depend, among other things, upon the distance from the enemy's lines, which impedes or permits the success of the work.

There has been but little change in the material employed for revetments. Metallic cloth and especially sand bags are largely employed. The revetment is indispensable in most cases to avoid caving-in of the walls. The entrance of water into the trenches is very rapid and it is necessary to provide numerous exits. Wells are placed at frequent intervals, and the bottom of the trench is covered with boards or rocks to permit the passage of the water.

To provide communication laterally and to the rear, communicating and approach trenches are provided. These trenches are protected from hostile fire by traverses, change of direction and tunnels. Their width depends upon their use. Eighty centimeters are sufficient to permit the passage in one direction, while widths up to 2 and 2½ meters are necessary for the

evacuation of the wounded and the bringing up of artillery. Some of these trenches are provided with machine guns arranged to sweep the front line trenches when the latter are taken. This immense system of trenches and branches makes a veritable labyrinth. To avoid getting lost it is necessary to place sign boards at all crossings and bifurcations of the trenches.

The passive defenses which delay and even stop the advance of the enemy, have not been overlooked in the present warfare, but have been perfected and used in large quantities. It is true, however, that the old obstacles such as trous-de-loup, abattis, and crows' feet, have almost entirely been superseded by barbed wire. The employment of the latter varies with the location and construction of the trenches to which it pertains. In the most advanced lines where the proximity of the enemy prevents the construction of ordinary wire entanglements use is made of chevaux-de-frise covered with barbed wire, Brun spirals and a variety of other ingenious portable wire entanglements which can be thrown over the top of the trenches. Even in lines farther to the rear, to prevent the enemy from hearing the noise of driving wooden stakes, use is made of iron stakes which screw into the ground. Wooden stakes may be employed in the works of the second zone or farther to the rear. In all cases entanglements are made of considerable width, 4 to 6 meters and in many places are constructed in a double or triple line. To destroy the entanglements use is made of wire cutters and artillery. The English have invented a clever device which is attached to the gun near the handle of the bayonet and which permits rapid cutting of the wire.

At the beginning of the war the shelters were very light, they were made of logs covered with earth and were to protect the garrison from rain and light shells. Later they were replaced by caves whose roofs were of the virgin soil and from 6 to 10 feet thick. Now extensive use is made of reinforced concrete.

The subterranean shelters for the garrison of the trenches are constructed to the rear and connected to them by galleries. Otherwise they are constructed off the communicating trenches but in every case there are several entrances to prevent one shell from sealing the occupants of the dugout. These dugouts are provided with every possible convenience, ventilating chimneys, beds, tables, etc. The supplies for the front lines are transported to storehouses near the front line by horse power or small locomotives. From there they are taken to the front lines thru communicating trenches in small hand-pushed carriages.

Where the trenches are separated but a short distance, the rifle and field gun lose much of their efficiency, great reliance being placed on hand grenades, mines, contra-mines and trench mortars. The Germans made use of a type leticular in shape, provided with various percussion points. These do not function very well and often fail to explode on striking the ground. Use is now made of a grenade provided with a time fuse which may be thrown without danger but does not permit of return by the enemy. On making a charge, certain soldiers of each assaulting battalion, skilled in this class of combat, go provided with shears, saws, and two bags each of which contain eight hand grenades. Both sides make use of special rifles which throw asphyxiating, incendiary or lachrymose grenades.

There are a variety of trench mortars used. Among these are included the Minenwerfer which are of a variety of sizes and which throw projectiles carrying from 600 to 1200 grams of explosive; others throw aerial torpedoes with wings, which weigh from 50 to 100 kilograms and which carry a heavy explosive. These small pieces need no special emplacement and can be placed anywhere. The same is true of the gas and flame projecting apparatus.

The machine guns, of which great use has been made, are placed, as far as possible, in concealed positions. Oftentimes they are in small concrete emplacements to protect them from the destructive artillery fire. Generally they are inactive till the enemy moves forward to assault, at which time they play the most important rôle.

The heavy artillery is placed well to the rear, screened from view oftentimes in concrete emplacements.

The telephone and telegraphic communications are very complete. Each commander is in direct communication with immediate units under his command. To prevent destruction by the artillery the wires are buried underground. Likewise the information furnished by aerial observers is very detailed. The enemy's territory is mapped in scales of 1 to 5000 and 1 to 10,000 in which are shown trenches, wire entanglements, camps, railroads, in fact, everything of a military value.

The second zone or zone of resistance possesses the same elements of defense as the first zone but to a greater degree. The trenches are deeper, the wire entanglements wider, and extensive use is made of reinforced concrete.

The third or rest zone is fitted up for the troops and the accommodations of stores. Here is formed everything which may be needed on the front lines. The transportation is truly marvelous.

[Development of Field Fortification in the Present War. By Gaetano Forni, Lt.-Col. of Artillery. *Rivista di Artiglieria e Genio*, Oct-Nov, '17. 7500 words.]

(An extended summary of a paper on this subject by Major Wilby, C. of E., published in *Professional Memoirs*, Corps of Engineers.

For comparison, the author quotes a German order dated June 20, 1917, published in *La France Militaire*.

This order explains how the heavy continuous lines, with deep shelters, which the Germans first constructed, failed under heavy bombardment. It prescribes instead an elastic system, consisting of loose lines of shell craters and machine gun emplacements, as a first defense, to slow up an attack; these to be backed up at a distance of one or two kilometers by several continuous lines of trenches, and these again, if possible, by other similar positions.)

This system, it would seem, has the disadvantage of requiring heavy forces massed in readiness for counterattacks; as for casualties, what they save in

FORTIFICATIONS—Continued

first line troops they lose in the second. Besides, as soon as the new system of defense appeared, the French and English changed their method of attack, as illustrated by the St. Quentin offensive of Nov 20, 1917, when the attack was led by "tanks."

The indications, then, are that the system of fortifications is not yet fixed. Changes may come at any time, and it is necessary to be prepared for them.

—Permanent—Armored Turrets

[Cupolas. By Maj. Julio Maldonado. *Mem. de Artilleria*, Dec, '17. 2400 words.]

(This is an historical sketch on the development of cupolas in land and naval warfare. The author discusses the various models in land fortifications and in battleships of various types and of different countries. He also discusses the armament of cupolas—their advantages and disadvantages.)

—Permanent—For Coast Defense

See
Coast artillery

—Permanent—Strategic Value of

[Old and New Views on the Value of Permanent Forts and Fortified Places. *Schweiz. Zeitschrift f. Art. u. Genie*, Sept, '17. 4500 words.]

Bernhardi's views are in contrast to those of Schlichting. More than the latter or von der Goltz he reckons on the principle of masses. He desires greater cooperation between defensive works and offensive operations. He holds that fortifications must not be considered as means of passive defense, but as aids to offensive warfare. It is true that a fortification plays an important rôle in local defense. Fortifications should be built for the protection of railroad junctions, important river crossings, stores, arsenals, and munitions factories. But the true function of the fortification is wider.

If strategical considerations require the defensive, as is generally the case in States which are wedded to neutrality, fortresses on the defensive front can materially assist the field armies, serving to guard their flanks and protect their supplies. If the army is forced to retreat, the fortifications can delay the enemy, especially if there is a line of fortresses whose artillery fire commands all points. Of course such a system entails all the weaknesses inherent in an extended cordon—forces are scattered on an extended front, beyond supporting distance of each other. The defensive system is thus placed on a false basis. The passive defensive of a place may also be of moral importance. Nevertheless Bernhardi agrees with Beseler that the fall of a place cannot decide a war, even when the place is a national capital. The fate of France in 1871 would not have been decided by the fall of Paris if she had had another considerable army in the field. The Boers continued their resistance for two years after the fall of Pretoria. In modern warfare, when nations are in arms, the fall of no locality can determine the outcome of a war. Neither can the passive defense of a place win the war. It can do no more than gain time.

Only the war of maneuver, in which all strata of society are called to arms, can determine the fate of a nation. Bernhardi, however, recognizes one exception. In the case of a small, ununified nation, whose defensive power is concentrated in one focus, the fall of that focus would be decisive. The fall of Antwerp would decide a war against Belgium and the fall of the Gotthard fortress a war against Switzerland.

But in a large state the fortress in itself no longer plays a decisive rôle. It must serve as an adjunct to the field army. At the beginning of the war it aids the mobile forces by protecting important points, by narrowing the practicable avenues of invasion, and by gaining time for the construction of provisional works. This rôle was well played by the Austrian fortresses on the Italian front in the present war. When the time for the offensive comes, a boundary fortress, especially a bridge head, can secure undisturbed passage of the boundary stream. According to Bernhardi the offensive value of fortresses is of wider scope than this. If the invader hopes to overwhelm the enemy at a given point, he must weaken his own forces at other points. Fortresses at other points on the frontier render this possible. The enemy must, to attempt the capture of such a place, employ much greater forces than the garrison. If he can be induced to make the attempt his forces resisting our attack are weakened, while our attacking forces are strengthened. To so induce him, the fortresses must be so located as to guard points whose capture would be of value to him, the garrisons must be sufficiently strong to make it dangerous for the enemy to ignore them, and the works must be strong enough to resist attack. Two such points are Strassburg and Breslau. The one guards the most important crossing of the Rhine into South Germany; the other guards the most important crossing of the Oder, flanks a Russian attack on Berlin, serves as a supporting point for a German offensive from the Mark or Prussia, or, with Cracow, for an Austrian offensive from the South, and guards Silesia against a combined movement of Russians, Poles, and Czechs.

Beseler, Bernhardi, Schlihcting, and von der Goltz all agree that a fortress should not be turned into an intrenched camp, into which the mobile army will shut itself, but should serve as a supporting and reinforcing point for maneuvering. Thus a Swiss army should not shut itself up in the Gotthard fortress to starve while an enemy revels in the Hocheben. Bernhardi goes farther. He holds that the fortress must hold up the greater part of the enemy's forces. This can be done only by an interacting line of fortresses. A few isolated forts on the frontier are useless. Bernhardi therefore advocates a second line of fortresses, as in the French system, which can enable the defender to assemble his forces for an offensive. His theories have been justified by the example of Verdun, which was held out against the Germans, threatened the German left, attracted vast forces to its attack, and gave the French an opportunity to assume the offensive elsewhere.

Should the secondary line be built as permanently in time of peace as the frontier line? Few points on this line will be of strategic importance under all circumstances. Such points, says Bernhardi, should be per-

manently fortified; those which will be of value only under certain circumstances should have complete preparation on paper, the artillery should be in readiness, and a skeleton fortification should be built, to be completed if circumstances require. Magdeburg and Mainz, for example, should be completely fortified. The plan suggested by Colonel Rothpletz for our (Swiss) forts constitutes such a system. We should adopt some such plan.

Beseler and Bernhardi agree that the fortress must have a radius of action as great as possible. Armor and armament must not be spared, and there must be a sufficiency of subsistence stores and munitions to prevent necessity of surrender. Had Port Arthur held out a few weeks longer, the whole war might have had a different result. However, the fortress must not be so extensive as to require an army for its defense, or to afford shelter for a defeated army. The fortress must support, not shelter, the army. It is a base of operations, not a protecting wall. The fate of Paris and of Metz in the war of 1870-71 teaches this lesson. All efforts of Trochu and of Bazaine to break he rings of the besiegers failed. The attacks of the besieged are bound to be frontal. A defeated army should never shut itself up in a fortress.

Bernhardi lays especial emphasis on the danger of half measures in fortification. He particularly decries fortifications incapable of all-round defense. Such a fortification, when turned, is useless, and the short time gained by the defense of such a place is not worth the money paid for its construction.

Bernhardi also discusses intrenchments from the standpoint of recent wars. In the war of 1877-78 the Russians intrenched themselves at Shipka and the Turks at Plevna, and each resisted for a long time the attacks of the numerically superior attacker. Plevna was the decisive point of the war. Its defense was of no ultimate value to the Turks. In the Boer War the Boers intrenched themselves constantly, and attempted to increase the resisting power of their weak forces. The English frontal attacks almost always failed, yet the defenders were at last compelled to give up their positions. In the Russo-Japanese War the Russians made extensive use of intrenchments, and constructed them with care and with great expenditure of materials. The Japanese advance was consequently slow. Nevertheless the elaborate Russian intrenchments did not avail to affect the outcome of the war. Bernhardi draws the following lessons. The only thing won by the war of spaces was time. This was of no use because the time was not used for offensive operations elsewhere. A protracted defensive is of no effect on the outcome of the war unless the time gained by the intrenchments is employed for offensive effect in some other locality. In fact, in the two earlier of these wars, the intrenchments would not have held out so long if the attackers had known how to dispose their forces for the attack.

It follows that the value of intrenchments is only relative. If they hold large forces of the enemy, while our forces carry on an offensive elsewhere, they are of value. Otherwise they are worse than useless, because they have an attractive power for the troops, induce them to rely on protection rather than on attack, and impair the initiative of our leaders. They are of great value to neutral states at the beginning of a war, if used properly. But here again, half measures are dangerous.

[Old and New Views on the Value of Permanent Forts and Fortifications. *Schweiz. Zeitschrift f. Art. u. Genie*, Dec, '17. 6200 words. 1 map.]

Having considered the various views as to the importance and value of the different fortification systems, we may now consider how these have stood the test of actual war. The following observations are in the main taken from a series of articles reviewed in the *Artilleristiche Monatshefte*. We do not agree in every particular with the articles, which, however, are stated to express the views of the American General Staff.

Liège.—This fortification was completed on the lines of Brialmont's plans in 1892. It consisted of a ring of forts about 6.5 km. from the city, commanding the main roads. There were six large pentagonal forts and six smaller triangular forts. The average distance between forts was 3700 meters. The garrison of each fort was 80 men; the armament two 15 cm. and four 12 cm. guns, two 20 cm. mortars, and three or four rapid fire guns, mostly under armored protection. The proposed additional field works had not been installed. At the time of the German attack the Belgian mobilization was not complete, so the fortress had a garrison of 20,000 instead of 30,000 men. The attack was made on the four forts of the southern sector. Fire was opened in the night of Aug 4-5; on the 6th the Germans brought up 21 cm. mortars, and apparently 28 cm. mortars and 42 cm. howitzers. These guns outranged the guns of the fortress, and the shells pierced the 3.7 meters thick concrete walls. The Belgians evacuated the city and all but the northern forts Aug 6. The latter were finally taken on the 15th.

Namur.—The ring consisted of nine forths, 4 km. distant from the city. The larger forts had each two 15 cm. and four 12 cm. guns and two 21 cm. mortars under armored protection; the smaller forts had each two 12 cm. guns and one 21 cm. mortar. The garrison of 25,000 men had time to construct the field works between the forts and the advanced trenches. The Germans brought against the fortress, besides smaller guns, 42 cm. howitzers and 30.5 cm. mortars of the Austrian motor batteries. Aug 21 the attacking infantry went into action, and at the same time the supporting points of the garrison were destroyed. The infontry and lighter guns advanced on the 23rd; the garrison abandoned the field works. On the 25th the infantry reached the city; five forts surrendered; the others, taken in rear, followed suit. The German fire had been extraordinarily heavy. One fort had only fired ten times and was itself struck by 1200 shells, 20 per minute. Fort Suarle was struck by 3500 shells from three batteries of heavy guns. The incidents of the attack on Namur were: silencing of the inferior artillery of the defense; destruction of the same; advance of the infantry under artillery protection; the breaking thru the intervals between the forts. Assault was superfluous.

The French Forts of the North Front.—Lille, Laon, La Fère, Rheims, only slightly modernized, fell with-

FORTIFICATIONS—Continued

out much resistance. Maubeuge, which complied with modern requirements, offered resistance. The intervals between the forts, which were from 5 to 6 km. from the city, had been carefully fortified in time of peace, and the forts, which dated from the Franco-Prussian war, had been strengthened with concrete, armor, and traditor batteries. Infantry positions, shelters, and wire entanglements had been prepared, and armored battery trains had been placed on the belt railroad. The fortress was surrounded by the German infantry. Aug 28; the garrison unsuccessfully attempted a sortie Sept 1; the siege artillery (26 cm. mortars, 42 cm. howitzers, and 30:5 cm. Austrian motor mortars) was in position Sept 3; its fire, beginning at 8 to 10 km. range, demolished the works; under artillery protection the infantry moved forward to the assault, and penetrated the intervals between the forts. Sept 8 the garrison of 40,000 men capitulated. The rapid success was due to the great range, accuracy, and explosive power of the German artillery, which had outranged the guns of the fortress and even reached the old Vauban city wall.

Antwerp.—This was considered the second strongest fortress in Europe, and was the prototype of the Brialmont fortifications. It consisted of two rings of forts, situated so as to take advantage of the swamps and watercourses. The inner ring was 4 km. from the city, had a circumference of 45 km., and consisted of 14 forts of the most modern type. The outer ring was 15 km. from the city, had a circumference of 100 km., and consisted of 19 forts. Strong permanent works were located between the forts. Many of the forts and works could be made safe from assault by inundation. The armament was the same as at Liège and Namur. The German siege artillery consisted of 21 cm. mortars, 42 cm. howitzers, and 30.5 cm. Austrian motor mortars. The attack was directed against the sector between the Dyle and the railroads running to the east from Antwerp. The forts in this sector covered a front of 15 to 20 km. The garrison sought to keep the enemy artillery out of range, but this was impossible because of the overwhelming numbers of the Germans. The artillery attack opened Sept 28; Oct 1 the first forts fell; Oct 6 and 7 the infantry captured the Nethe sector; Oct 7-8 the bombardment of the inner line began; Oct 8 two forts of this line fell; Oct 9 the garrison evacuated the city. The German military writer Frobenius attributes this rapid success of the Germans largely to the lack of offensive spirit on the part of the garrison. Not only was no attempt made against the German line of communications, but the commander of the fortress limited himself to a passive defense, apparently having no understanding of the proper function of a fortress in modern warfare. The task of the attacker was therefore easy; he had only to station his superior artillery beyond the range of the guns of the forts, and knock the latter to pieces.

Verdun, Toul and Belfort.—These places were all covered by a ring of forts well advanced, which were amplified by field fortifications. From the first forward movement of the Germans to the present time the troops defending Verdun and Toul have carried on offensive operations against the German positions in the plain of the Woevre, on the Meuse, and in the Argonne. As a result the Germans have won little ground. Similarly the garrison of Belfort took advantage of the situation at the foot of the Vosges to move forward into upper Alsace. During the battle of the Marne Verdun served as an unshakable supporting point for the right wing of the French army, and materially contributed to the success of the latter. In 1916 its active defense not only resisted the German attack, but succeeded in driving the enemy back to his original position. In addition to the offensive spirit of the defenders, other factors contributed to the French success. Verdun and Toul, as also Belfort and Epinal, constituted, together with the intermediate chain of barrier forts, the flank points of strong, coordinated defensive positions, in defense of which not only the garrisons but also parts of the field army could co-operate. Neither Verdun nor Toul could be besieged so long as the Verdun-Toul position formed the supporting point for the right wing of the entire French position. This co-operation of fortress and army was the secret of the French success.

Przemysl and the Russian Fortresses.—Przemysl had two lines of forts. The inner consisted of a chain of works, connected by thin earth walls, 12 km. in circumference, 6 on each bank of the San. The outer line, 40 km. in circumference, consisted of independent forts with minor works and batteries between; twelve or thirteen forts on the left, and seven on the right bank of the San. The distance of this ring from the city was 6 km. The Russians surrounded the fortress Sept 20, 1914, but soon gave up the siege. They renewed the siege Nov 12. As they did not possess adequate artillery, they relied on starvation, being successful Mar 22, 1915. Two days were sufficient for the recapture by the Central Powers in May, 1915. The Russians attributed the loss of the city to lack of munitions, but in fact the German and Austrian siege artillery were largely responsible. Of the fortresses on the Russian west front, the most important was the Polish triangle, Warsaw-Novo Georgievsk-Sierock. This triangle played an offensive as well as a defensive rôle. The former two, on the Vistula, served as bridgeheads which secured the unhindered passage of the river to the Russians, thus checking the German advance. Novo Georgievsk served the same purpose for the Narev, and Sierock for the Narev and Bug. The sides of this triangle were 30 km. long. On the sides toward Germany and Austria the rivers served as immense wet ditches. As each of these fortresses was protected by the two others, it could be attacked only on the river side. A siege was impossible unless the whole position was besieged. The garrison of the triangle was 100,000 men; the armament 2500 guns; it is doubtful whether the guns or the forts were up-to-date. The importance of this triangle was increased by the fact that it was adjoined by another triangle, one of whose sides faced Austria and another both Germany and Austria. Two points of this triangle—Warsaw and Ivangorod, about 100 km. apart—were on the Vistula; the third—Brest-Litovsk, 180 km. from Warsaw and 140 km. from Ivangorod—was on the Bug.

Warsaw and the fortresses of the Russian west front were evacuated during the German-Austrian advance which followed the break thru the Russian front at the Dunajec in the summer of 1915. In most cases the defenders were maneuvered out, tho in some cases the fortresses were bombarded. As a rule the evacuation occurred so early as to warrant the belief that it was deliberately planned by the Russians, possibly because the armament did not correspond to the money spent on it. An exception was Ossowiez, on the Niemen-Bobr-Narev line, which owing to its situation in swampy terrain offered unusually long resistance. The German attempt to envelop this fort in 1914 failed; the Germans then brought up heavy artillery, but the Russian batteries were so well placed that the German guns did not locate them, whereas the Russians silenced some of the German batteries. As warm weather approached, the swamps made it difficult to place heavy artillery. The fortress fell Aug 22, 1915, during the general Russian retreat after the fall of Warsaw.

Bukarest.—This fort was constructed between 1885 and 1896 by Brialmont. It was similar to the Belgian fortresses. The main reliance was on a strong ring of forts with intermediate works and batteries, the guns being generally in armored turrets. In addition there were movable armored towers whose use was facilitated by a belt railroad. At the beginning of the construction of the fortress thre was held a competitive test between Grman and French armor and guns, as a result of which the output of Krupp and Gruson was adopted. On account of the large extent of the city, and the level character of the terrain, the chain of forts, 6 to 9 km. from the city, had the large circumference of 75 km.; there were 18 forts about equally spaced, and 18 intermediate works. A permanent central work, and an interior polygonal wall 30 km. long, were planned but not built. It was planned to install, in time of war, field works and batteries between the forts and the city. All this required a garrison of from 80,000 to 100,000 men, and an armament of 60 armored towers for 12 and 15 cm. guns, more than 70 carriages for 21 cm. howitzers, a great number of disappearing carriages for rapid fire guns, and 400 field guns as a mobile reserve. The military importance of Bukarest lay in its central location between the Danube and the Transylvanian Alps, on the main roads from Siebenburgen to the river, and in the concentration therein of the most important military factories of the country. Like most of the Russian fortresses, the Brialmont system at Bukarest was not put to the test of an obstinate defense; the outlook for success was not, however, great. The artillery defense was based on the theory of the unlikelihood that armored turrets would be struck by hostile fire. In view of the enormous explosive power of modern shells, actual impact on the turret is not necessary; if a shell strikes the concrete surrounding the armor, it will put the turret and gun out of action. Under the double pressure from the Transylvanian Alps and the Danube, the Rumanians were unable to furnish the necessary garrison for the city, and consequently they dismantled the fortress and transferred the mobile guns and armor to the Sereth line.

The conclusions of the American General Staff are as follows: The failure of the forts in the present war is due to the following causes: (1) That they were built a number of years before the war, and consequently the details of their construction were known to the enemy, the value of the concealed positions being thus lost. (2) That their armament was not up-to-date, being much inferior to the artillery used in the attack. (3) That the garrison permitted the enemy to bring his guns within effective range of the forts, without coming in range of the fortress guns. The advantage of concealed postions on the part of the defender is shown by the events at Ossowiez and at Verdun. The experiences of this war confirm the lessons from the siege of Port Arthur, that the placing of heavy guns in a fort to combat the guns of the attacker is a great mistake. It seems much better to place the fortress artillery in batteries behind the line of forts, and to rely on concealment rather than cover. The forts, whether permanent or constructed after the outbreak of war, should be designed only for infantry garrisons, and the main line of defense should consist of a coordinated system of trenches with machine-gun emplacements in front of the line of forts. The forts must serve principally as supporting-points for the organization of counter-attacks if the front is broken. The garrison must be strong enough to prevent the enemy from coming within effective range of the city or other protected point, and its activity must be supported by guns which exceed those of the attacker in caliber and range. The guns must be distributed over a wide space, advantage must be taken of the terrain for cover, and much reliance must be placed on the mobile guns, some of which must be greater than those which the enemy is likely to bring into position. The fortress of the future must enclose a great space which must afford the greatest possible freedom of movement for the troops and guns. Easily visible forts of masonry and armor are unnecessary. Permanent gun emplacements are only necessary at important points. The mobile artillery should be placed in concealment in earthworks so that they cannot be attacked by direct fire. A long resistance cannot be offered unless the garrison is strong in mobile troops and guns. Trenches furnish better protection than a deliberately planned fortification.

We cannot here criticize these conclusions. That has been done in part in the preceding installments of this article. They serve to emphasize the point which we have been making, that views on the value of fortresses and fortified places, and on their plans and armaments, have been diverse and conflicting. It is a reminder to us not to adhere to a foreign scheme, but, with due regard to the leading viewpoints to accommodate the national defense system to the local peculiarities and to the economic and military possibilities.

This discussion would be incomplete without reference to the recently published "Deductions from the World War" by Lt.-Gen. von Freytag-Loringhoven of the German General Staff. After alluding to the increased use of heavy artillery and to the frequent elaboration of field trenches into fortified positions, he makes the following observations: In the future strengthened trenches will take the place of fortresses.

FORTIFICATIONS—Continued

The medieval idea of holding territory thru fortifications must be abandoned. As Napoleon remarked, fortresses are only weapons, which must be used in aid of operations, and since it is impossible to predict the course of the latter, it is best to build fortifications during the war where they are needed. This is an exaggeration, since prepared supporting-points should be established at places where the necessity of a defensive rôle can be foreseen. The value of such supporting-points was demonstrated at Verdun. Nevertheless the fortification of great cities is obsolete. Such fortresses can only be used as supporting-points in fortified zones. Certain border districts may be provided in time of peace with a chain of permanent fortifications which can be amplified in time of war by means of material previously prepared. These should serve as central points of defense in entrenched sectors. The world war has confirmed the old truth that a decision can be gained only by the offensive, and that maneuver war, rather than position war, should be sought. It has also demonstrated the immense power of a defensive supported by well-planned fortifications.

From all the foregoing views we derive the following conclusions: The future Swiss defense system must depend on the preparation of fortified zones with the erection of permanent central points for whose amplification during war provision can be made during peace. We must not adopt any system blindly, but must conform our plans to local, economic, and military circumstances. We must bear in mind the rapid obsolence of forts and armament, and we must remember that the army will have in time of war an essentially defensive rôle.

FORTRESS ARTILLERY

See also
ARTILLERY
COAST ARTILLERY

FRANCE

—Aeronautics

See
AERONAUTICS—FRANCE
AERONAUTICS—GERMANY
AERONAUTICS—ORGANIZATION AND ADMINISTRATION (Article: "Air Power—Organization of Flying Troops")

[Reorganization of German Units. *Army and Navy Gazette,* July 20, '18. 250 words]

The present German division comprises three infantry regiments, each of three battalions of five companies, one of which companies is a machine gun company, having 12 guns of heavy type. The strength of the average company (normally 250) is 150 men. Fresh divisions may have 200 officers and men per company. This would give an infantry divisional strength of about 7000 to 9000. Add to these 3000 for two regiments of artillery and reserve companies of machine guns and minenwerfer. Since the beginning of the war and up to September, 1917, Germany had created 116 new divisions (making 239 in all) but only 822 battalions. However, the number of divisions in a corps has been increased from two to four or five, and so the corps are little smaller. The deficit is made up by machine guns and artillery.

—Army

[The French Revolutionary Armies and Discipline. From *Revue des deux Mondes,* Oct 15, '17; *Norsk Militaert Tidsskrift,* Feb, '18. 2500 words.]

1. *The first crisis.*—The old French royal army had not a high standing; the hired soldiers belonged to the lower classes. They were good fighters, but neither faithful nor law-abiding. While Frederik II of Prussia had formed strongly disciplined troops of his hired soldiers, the troops of the king of France more and more gave themselves to disorder. One minister of war, St. Germain, tried to introduce the Prussian spirit but without success. Each people has its own temperament. Things went from bad to worse when the revolution came.

The people who made the revolution may be divided into three categories. Firstly, the leading, well meaning men, lawyers, moralists and citizens who yearned for liberty and detested anarchy. Most of these people had a plan of a new constitution in their pockets, the best will to eliminate abuses and to make their fellow citizens happy. Regarding the army, they wanted to substitute the weak royal discipline for a strong national discipline. The second class were those who wanted to abolish the evils under which they themselves had suffered. To the third class belonged the violent elements who influenced the masses and confused the legitimate aims of the revolution. All these elements were also found in the army. According to the decree of 1871 from the minister of war, Marquis de Segur, nobody but a nobleman could advance to officer and nobody could advance to the higher ranks without having six noble ancestors. Consequently men like Hoche, Kleber, Ney, and Moreau could not be officers. Bonaparte and Davoust could not be colonels, and at the same time regiments were sold or given away to very young noblemen, the so-called "colonels with bib" (colonels à bavette. When the revolution came lots of commanders joined, even noblemen who had worked for better conditions. From the beginning the soldiers joined the masses. During the first half of 1790 a complete dissolution of the discipline was seen over the whole of France, which culminated in a great mutiny of the regiments at Nancy, which was put down with the assistance of the garrison of Metz, who had remained faithful.

The 22nd of May, 1790, the constituting assembly declared that the French nation renounced all wars of conquest, after which the pacifists at once announced disarmament thru which France was going to lay the foundation of perpetual peace. Mirabeau tried to explain that unless the rest of Europe was willing to disarm it was better to wait, until then the perpetual peace would be a dangerous dream. Robespierre answered that France ought to consider her frontiers at that time fixed by the eternal destiny. As Europe let France alone during the first year of the revolution, the pacifists went on proclaiming the impossibility of war, because it was not wanted in France.

Under these circumstances it was impossible to raise an army. The more "patriotic" it declared itself, the more "Jacobine" it became. The officers did not dare to interfere. It even happened that soldiers meeting their officers shouted: "A la lanterne"! (to the lamp post!) and if they did not lay their hands on them themselves they transferred the lynching to the excited mob. The government and the National Assembly made an effort to correct things, but no action was taken. Some decrees were issued, one of which said that the principles of equality and individual liberty should be kept in all institutions.

This decree was misunderstood both by the authors and those who were going to bring it out in practice. It broke down the discipline still more. During the whole year of 1791 soldiers were seen in more or less violent conflicts with their officers in the whole country. If the culpable soldiers were punished they were soon pardoned. This culminated in setting at liberty all those unpunished for the mutiny of Nancy, who were brought in triumph thru the streets of Paris and paid homage by the National Assembly in full. The aim of military law was more to punish despotic officers than refractory soldiers.

The attitude of Europe becoming more threatening, the National Assembly found it imperative to get the start of the enemies. Two years after the frontiers had been "fixed by destiny" and the pacifist proclamation of "perpetual peace," the National Assembly compelled the king to declare war against Prussia and Austria, before the other powers were ready to interfere (Apr 20, 1792), feeling sure that the discipline would at once be established by the sound of battle. "Ca ira"! was the catchword of the day.

On the 28th of April the French marched against the Austrians in Belgium in the north and the Prussians at the Rhine in the east. Gen. Dillon marched with one army corps from Lille to Tournai. At the first sight of the Austrians the French turned their backs on their astonished adversaries. Shouting "Sauve qui peut" they fled back to Lille and murdered their general and other officers on the way. Gen. Biron simultaneously marched from Quiévrain against Mons. On account of the uncertain attitude of his troops, he himself ordered a retreat, which soon was converted into the wildest flight, during which officers and others who tried to stop them were trampled down.

Fortunately the Austrians were not fully prepared and could not start a pursuit. But all Europe made capital fun of this new kind of Frenchmen who now shouted: "Vaincre ou courir!" (victory or run) instead of their old "vaincre ou mourir!" (victory or death). One foreign diplomat predicted the end within a month, which might have happened if the coalition had been ready to march on Paris.

The French soldiers were ashamed and asked to be led against the enemy anew, but the generals knew too well the root of the evil to believe in a rapid cure. Gen. Dumouriez was authorized by the National Assembly to reform the army, and simultaneously a new code of rules was adopted. The troops were drilled in training camps along the frontier; the training was so successful that the soldiers themselves craved discipline and the punishment of disobedience. Danton, who had himself preached mutiny, now understood that discipline had to be upheld and consequently did all to strengthen the authority of the general. While Danton preached "L'audace" in Paris, he left to Dumouriez and Kellermann the strengthening of the discipline in the army.

On the 20th of August Gen. Dommartin could write from the camp at Sedan: "We have succeeded in building up a discipline such as never before. When the National Assembly offered the soldiers to choose their own officers, they answered that this would be the greatest misfortune which could happen.

The consequences soon showed themselves. The Prussians retreated after the affair at Valmy, the Frenchmen crossing the frontier and occpying Mainz. Dumouriez defeated the Austrians at Jemmappes. This was the old army, reinforced by some volunteers.

2. *The new crisis.*—During the course of the autumn of 1792, discipline slackened anew, and new efforts had to be made to strengthen it again. This new crisis had several causes. The two most important were the easy liberation of French territory and the new mass conscription in 1792.

The volunteers of 1791 had willingly submitted to the strict military discipline. Dumouriez had chased away every mutineer as a traitor. But the great mass of new volunteers called by Danton in 1792 principally belonged to the mobs which had participated in the street fighting of the revolution. Such fighting does not know any definite rules. Used to the tumults of the clubs, they brought habits to the front which were an abomination to the old soldiers. They had their contracts, had the right to return home after a campaign, and to choose their own leaders. Sometimes they made good selections: Bessières, Suchet, Victor, Oudinot, Davoust, and Moreau became battalion commanders in such elections. But the system caused agitation and killed the respect. "Qui t'a fait roi?" any volunteer could ask the commander chosen by himself, when he tried to maintain discipline. And the commanders who were not chosen by the troops were suspected to be aristocrats and against the revolution.

Added to this the French armies were in a rich foreign country, occupied without hardships. Jemmappes was the only battle of importance which had cost any exertion. More than one soldier found his Capua in Brussels or Mainz. The discipline was low. The soldiers left the camp without permission and went round the country in bands committing all kinds of excesses.

Courage as well as discipline sank low. The battle at Neerwinden was lost 20th of March, 1793, and Belgium was cleared of French troops. "Never," Captain (later Marshal) Soult wrote from there, "has the army been in a worse condition than now.

Simultaneously the coalition against France grew to embrace England, Russia, Spain, Piedmont and the smaller German states, so that the whole German empire was taking part.

Besides new military laws a new, powerful exertion

FRANCE—Continued

had to be made to save France. Carnot now possessed the authority from the Committee of Welfare. The National Assembly prohibited (December, 1793) the troops to send in deputations, whereby one of the worst causes of the lack of discipline was done away with. Martial law at the Rhine condemned 62 persons to death, 34 to chains, 34 to prison and 36 to degradation during the time 7th October, 1793-16th of March, 1794. Carnot had made up his mind to lead the patriotic enthusiasm into military channels. In his orders to the commanders he says: "No harshness of manners, but great strictness in the execution. Discipline ought to be founded on confidence and love of the fatherland. The same degree of strictness for high and low. A reverse is no crime, when everything possible has been done for victory. No excesses, which dishonor the French soldier. Put a stop to transgressions and get rid of all bad elements!"

It seems to have been a principal point with both Dumouriez and Carnot to get rid of suborners and others exercising a bad influence on the soldiers. It is strongly pointed out, that no pressure must be brought on the government. The armed power does not reason; it obeys and executes. It must not pronounce itself, either spontaneously or individually, which would make it liable to punishment, because unity is its strength. Carnot wrote, that discipline is the glory of the soldier and the strength of the army; it is the surest means of victory. By the strength of it all wills are united in one, all are striving for a common aim.

Later the emperor said, with his long experience, that discipline is the first virtue of the soldier; bravery comes second.

In this manner an army was created of the masses, after the people had got away from the influence of the towns. In another way than originally thought the weak royal discipline was replaced by a powerful national discipline, built on popular participation and approval.

The same Soult, who had previously complained of the dissolution of the army, later wrote that the same love for the cause and abnegation existed in all the ranks of the army. Carnot said that the soldiers willingly submitted to a stricter discipline than under the old absolute monarchy.

By and by a type of soldier was created, which scarcely has been seen since the classical age, and which hardly has been surpassed by modern troops. The soldiers were on a confident footing with their officers who often joked with them and sometimes received crude answers; all of a sudden they were serious fighters, perfectly safe in their commanders' hands and flexible as a blade of tempered steel. And in a strange way the principle of liberty and equality had been effected.

The man is free who is willing to do what is demanded, and the one who does his duty wherever he is placed as well as his commander, is his equal in the best meaning of the word. Corporal punishment was out of the question. They would not have stood for it. They were proud and strong, and the discipline became part of them by and by.

These modest privates in reality make a more sympathetic impression than the emperor and all his marshals. They are among the best products which this wonderful France has possessed. The type has been immortalized by the English author H. Seton Merriman in his masterly book, "Barlasch of the Guard," and its spirit pervades the mass of diaries and letters written by soldiers during the revolution and the empire.

—Army—Organization

See also

GREAT BRITAIN—ARMY—ORGANIZATION (Article: "Impressions of a Visit, Etc.")

—Army—Sanitary Service

See also

VENEREAL DISEASES (Article: "The Combat Against Disease During the War")

[Military Mission to the French Army. By Dr. Mariano Gomez Ulla. *La Guerra y su Preparación*, Jan, '18. 12,600 words. Photographs, figures.]

General Shops of the Sanitary Service

This establishment was first started a little over two years ago thru the influence of Justin Godart, Chief of the Military Sanitary Corps.

During our visits we saw workshops, construction shops, and training schools operated under the supervision of doctors and specialists from the engineers.

The advantages of this system are numerous besides the economy in men and money which results, the especialization of personnel makes for progress and facilitates the introduction of new ideas.

Up to the present the sanitary service shops repair and construct matériel of current type; nothing new has been constructed as yet.

The shops are at present located in a large garage which has been extended and improved. This is only temporary, however. The following is a list of the units constructed at this factory, with some details of equipment of each unit.

1. Surgical auto ambulances consisting of 3 camions A, B, and C; a small camion, and a truck for carrying personnel.

Camion "A" carries:

1. Steam generator with accessories, rear of camion.
2. Sterilizing and cleaning apparatus.
3. Heating apparatus.
4. Necessary linen goods.

The camion costs 34,242 francs complete.

Camion "B" contains the following:

1. Electrical material for lighting the entire group and for radiography, etc.
2. Radioscopic material.
3. Operating room, complete.
4. All photographic material necessary for X-ray work. The cost of the camion with its equipment is 23,998.45 francs.

Camion "C" contains:

1. Electrical generator with accessories.
2. Radiographic material.
3. General utility material.
4. Surgical instruments properly stored.
5. Apparatus and material for treating fractures.
6. Gardening instruments. The price of truck complete, is 37,116 francs 65 centimes.

The small truck carries:

1. Medicines and general utility material, and costs 15,642.50 francs.

Material and apparatus is ingeniously placed so that it can be rapidly loaded and unloaded. The complement consists of four surgeons, and four assistants, an X-ray man, one chemist, and one administrator.

There are also one sergeant, one steward, and ten male nurses, who are all students of medicine, besides three corporals, eleven nurses, four chauffeurs and two mechanics.

There are 23 of these surgical groups in existence attached one to each army corps or field army headquarters. They do not attend to the lightly wounded, these cases being sent to the rear. These stations only care for serious cases needing immediate attention. The stations are established from 10 to 30 kilometers behind the front lines, depending on the local conditions.

The advanced surgical group, which has been suggested by Dr. Proust as a means of caring for operating cases alone, is similar to the above described ambulance group insofar as operative material is concerned, except that it has necessary fixtures for 100 beds, and is divided a follows:

1. Administrative Section—One camion with moving kitchen in trailer.
2. Transport Section—With motor transportation for entire personnel.
3. Operating Section—Three camions with trailers carrying tents and other equipment.
4. Hospital Section—One camion with trailer carrying a Bessonneau tent and equipment for sixteen beds complete.

Dr. Proust proposes the following complement for the above organization: 10 doctors—including one commander and three operating teams of three doctors each; two administrative officers and one pharmacist; a total of 60 enlisted men.

When this group is established for operation, it is built up around the operating room as a nucleus. The operating room has canvas roof, wooden walls, wooden floor covered with linoleum, and is provided with interior walls which are used to hide the heating and sterilizing sections, but which can be easily adjusted according to the floor space necessary in any case. Around this operating room are grouped the wards and offices, all joined to a central corridor which is built of canvas on a wooden frame. The entire construction is painted green on the outside and white on the inside.

To give some idea of the work accomplished with the ambulance group, Ambulance Group No. 12 cared for 2796 seriously wounded, almost all of which were operating cases between Apr 8 and June 8, 1916. This group worked double shifts night and day.

The process was as follows: Every wounded man who arrived by the divisional ambulances was taken to a receiving ward where he was stripped and his possessions taken on receipt. He was then examined and prepared for the necessary treatment in his case.

The X-ray officer designated to the nurses those cases which needed X-ray examinations and would send results of his examination marking plates with numbers corresponding to a marked place on the body which had been photographed. In difficult cases the X-ray officer attempted to determine the depth of bullet, shrapnel, etc., by the Haret method.

Each operating surgeon had two tables so that no time would be lost in changing patients. At the end of each operation the surgeon would dictate to the secretary his observations on the case in a medical notebook which followed the patient wherever he went and was kept always at the head of his bed in the hospital. As to the length of time for each operation, it may be said that an experienced surgeon averaged two cases per hour.

Out of 2796 cases treated, there was a mortality of 14.52 per cent—78 cases were lost within 24 hours after operating, 50 cases 3 or 4 days after operating, and 406 were lost on account of different complications.

Complementary Surgical Group

This group was formed because of the necessity of a lighter, more inexpensive, more mobile group, nearer the front lines.

It consists of a single camion and trailer. The camion weighs 4500 kilos when loaded. The equipment consists of: 1(1) Sterilizing apparatus; (2) Electrical apparatus for all necessities; (3) Radioscopic material; (4) General utility instruments; (5) Heating plant; (6) Operating room.

For operation in Salonica, a very light type of complementary surgical group has been designed. It is similar in equipment to the above described outfit but mounted in three light camions.

It is the author's belief that all surgical groups of this sort will sooner or later be mounted in many small light trucks instead of in two or three heavy ones.

Apparatus for Suspending Stretchers in Hospital Trains

The author gives only one type, which consists of a heavy wooden brocket hung or screwed onto the wall of a third class car. There is a heavy hook on the lower part of the vertical bracket base and a chain ending in a hook is attached to the arm of the bracket so that both hooks are on the same level, and hold one end of a stretcher.

Dentist's Truck

This truck weighs 4200 kilos and has an average speed of 25 miles per hour. It costs complete 21,000 francs.

The equipment consists of:

1. Dental instruments.
2. Dentist's chair.
3. General accessories.
4. Dental medicines.
5. Furniture (wood).

The camion is divided into two parts by a light wooden partition and is a complete laboratory, operating room, and office in itself. It has windows and a roof which can be opened. Two large doors at the end of the truck are swung open and are used as entrance and exit.

The personnel consists of a dentist, a specialist, two mechanics and a driver. Sixty to eighty cases can be cared for in one day.

FRANCE—Continued

Mobile Washing and Drying Group

This group consists of two heavy wagons drawn each by one team of horses. One wagon contains a boiler, a washing machine, and two water tanks—one for hot, the other for cold water. The second wagon contains a 4 horsepower motor, a hot air dryer, a centrifugal pump and centrifugal washer. The group has a capacity of 1000 kilos of clothes per day in warm weather.

Ice Water Wagon

This wagon weighs 4800 kilos and costs 14,500 francs, consists mainly of a Panhard-Levasseur motor, an Andiffren-Singrun ice machine, ice cases, and receptacles for the necessary chemicals. It produces great quantities of ice at a low price, for use in hospitals and around the cantonments.

Body Hygiene Groups

These consist of a large double-wall tent divided into three compartments, and three small tents. The large tent has a wooden floor and contains the shower room, 40 shower heads, the dressing room, and the boiler disinfecting room where clothes and leather goods are disinfected in a Geneste stove, over which the bathing water is heated. The three small tents are receptacles for clean and soiled clothes This group handles about 1000 men per day.

Radiology in the French Army

Modern war surgery would be impossible without the X-ray machine and its consequent photographs. This is the first war in which it has been essential to have X-ray plates of various cases taken near the front lines. Drs. Hirtz and Sabatier developed the French X-ray units from practically nothing, until in the middle of 1916 the French Medical Corps had about 600 separate units with which all cases could be handled.

The units are classified much as the hospital units are, that is, as advanced groups, territorial, and divisional groups.

The number of units of their class employed in the zone of operations is not very large. The models are extremely varied, the most serviceable one being the type built by the Gaiffe-Galot firm. These machines are equipped with a very reliable motor making as much as 25,000 kilometers without a single breakdown. They average 30 to 35 liters of gas to the 100 kilometers.

The material is very well divided in these coaches as follows:

1. Generating material.
2. Material and accessories for radioscopics.
3. Photographic material.
4. General utility material.
5. Varied electrical material.
6. General implements and accessories.

This outfit costs 25,000 francs. X-ray photographs cannot be taken in the truck itself on account of the vibration of the motor; the station is usually established in a house.

The Re-education of War Invalids

The work of salvaging war wounded is done under the direction of doctors at certain centers such as at Charleroi in Haimant Province, and another one in Brabant Province. Great porgress has been made in the construction of orthopedic instruments so that now it is considered that any man who has been amputated below the upper arm joint can be used, especially in farm work.

There are at present 2000 cases of total blindness as a result of the war and the education of these blind soldiers is given a great deal of attention. There is an electrical instrument in use by which the exact degree of blindness can be determined. All blind soldiers receive a daily pension from the government of 3.55 francs and can augment this by such money as they make in the professions that they are taught.

The Belgian and British Governments are also taking care of and re-educating their mutilated so that they can become productive members of the community. The science of reclaiming the maimed soldiers is being constantly developed and now inter-allied conferences are being held so that the work can be more unified.

Besides the many individual schools and hospitals existing for the purpose there are four schools in Paris for the training of invalids. The main one of these is directed by Dr. Vallee, himself a war invalid, and takes care of some 300 men who need medical attention before they can be trained in any profession. These men are usually suffering from some nervous trouble.

A careful study of each individual case is made upon admittance to the hospital, and each case is given great attention as to its own requirements until discharged.

The Maison Blanche school has cared for 664 cases and out of the 664, 410 have been returned to work.

The Quai Debilly has an attendance of 100 and pupils are given a general culture course in addition to their regular training.

The Juvisy school trains men for farm work and has a capacity of 500.

The Belgian relief center and training center for invalids is at Por-Villez and cares for some 2000 men.

This entire service of reclamation is under the French Service of Military Sanitation.

—Army—Signal Corps

See also

WIRELESS TELEGRAPHY—GERMANY

—Army—Supply and Transport

See

INFANTRY—INSTRUCTION AND TRAINING (Article: "Maneuvers of French Divisions in Instruction Camps")

MOTOR TRANSPORT—FRANCE

SUPPLY AND TRANSPORT—FRANCE

—History

See also

EUROPEAN WAR

FRANCO-PRUSSIAN WAR

GREAT BRITAIN—HISTORY (Article: "Anglo-French Relations")

—Military Policy of

[Democracy and Military Service. By Maj. J. R. M. Taylor. *National Service*, Oct, '17. 5000 words.]

(A description of the system of military service proposed for France by the socialist leader, Jean Jaurès, in 1910. Altho never adopted, the system is in several respects being approached by France under the stress of war It is an interesting project for organizing a nation in arms to defend its own soil, and for organizing it in such a way that at no time can the army forget that it is in fact the nation.).

[Unity of Direction. *Army & Navy Gazette*, Feb 9, '18. 800 words.]

For several months the Paris press has manifested a lively interest in everything pertaining or purporting to pertain to the higher direction and command of the British Armies. The slightest indication of public opinion with regard to this all-important matter has been faithfully recorded, and the subject has never been long absent from the columns of the daily newspapers. The reason for this intense preoccupation is, of course, the very natural desire almost universally entertained to see the control of all the operations in France and Italy pass into the hands of a French General, not necessarily a generalissimo, but Chief of the Staff to the Supreme Allied War Council, which now meets from time to time at Versailles. If we consider that France is invaded and that the decisive battles of the war must in all likelihood take place on French soil, we shall be better able to appreciate the reasonableness or otherwise of this French solution of the problem of unity of direction on the Western Front. If unity of direction is necessary it can evidently only be obtained by one side agreeing to take orders from the other, however much these orders may be theoretically those of an Allied War Council.

But if England is expected to rise to the occasion and show a generous spirit in a great cause, to the extent of effacing herself, in great measure, with regard to the direction of the war on land, some concession to professional susceptibilities may be expected of France. There is one name that should rally to French control the support of all the Entente Powers. No soldier is so popular in England and America, and no French soldier has so great a claim on the gratitude of his countrymen as Marshal Joffre. The victor of the Marne has all the qualities required of the responsible adviser of a Supreme War Council: courage, calmness, decision, technical knowledge, experience, tenacity, health and great ability. Place him in the position to rival Hindenburg, who is five years older, and without doubt he will do what Hindenburg has done. He will direct the combined forces of many nations where success may best be gained or the enemy's plans frustrated.

FRANCO-PRUSSIAN WAR

[The War of 1870-71. By H. M. *Schweiz. Monatschrift aller Waffen*, Oct, '17. 1800 words.]

Between Oct 17 and Nov 9 battles occurred between the Seine and the wood of Marchmoir, between troops of the Châteaudun district and Wittich's troops, which show the difficulty of combatting seasoned troops with poorly organized and poorly led units. Sept 23 General d'Aurelle was made commander in the western district. He had to organize a staff of untrained men. The covering troops were too much extended, and were mingled with units of the 16th Corps. They received orders from everywhere. Volunteers and reservists were organized, shifted, and disbanded. Châteaudun, in the southern part of the district, was fortified, and was held by 1800 volunteers, who had 60,000 cartridges. The forces in the environs were out of touch with each other, poorly supplied, and without a base.

When the Germans learned of the gathering of forces in the west, the 22nd Prussian division marched against them from Orleans, Oct 17. Cavalry detachments moved against Mantes and occupied Rambouillet. Maj. Lipowski had prepared the defense of Châteaudun well, but had neglected reconnaissance. Accordingly the French were surprised. The fighting lasted about 9 hours. The French withdrew to Tours. The raw French troops fought well. During the next few days the French evacuated Chartres, Maintenon, and Dreux. The Germans occupied Chartres. Two separate French forces advanced to occupy Dreux, and, mistaking each other for the enemy, engaged in a bayonet fight, and then withdrew demoralized. Wittich occupied Dreux Oct 24, thus securing the whole line of the Eure.

[The War of 1870-71. By H. M. *Schweiz. Monatschrift aller Waffen*, Nov, '17. 1500 words.]

Meanwhile Redern's mixed detachment from the 5th Cavalry Division, moving on Mantes, became engaged with the Mobile Guard under Mocquard near Chaufour. The French fought so well that Redern had to turn aside. The French slowly retired, and Redern halted at Mantes. The French opposed strong resistance at all points. However, it was not co-ordinated. Fiereck, the French commander, had no reliable staff; his chief of staff was commanding a sector; the troops were undisciplined; the service of communications was inefficient; the officers lacked military training; the troops lived on the country, which was already largely drained of supplies. The munitions supply was complicated by the fact that the troops were diversely armed, and the artillery matériel was diverse. Horse equipment was lacking. The troops were untrained. The service of security had to be performed close to the main body, even at the risk of exposing the latter to artillery fire. To these elements of disaster were added the blind belief in the passive defense.

Wittich had accomplished the first part of his task by the capture of the line of the Eure; as the army command believed that the French would make every effort to raise the siege of Paris, he was ordered to remain at Chartres, where his position was precarious. Meanwhile the French succeeded in organizing their forces in eight brigades (largely on paper) of which four and a reserve detachment were on the Perche from La Chapelle to Belhomert (17,400 men); three and a reserve on the Orne from Belhomert to Bonoth (17,400 men); 8000 men on the Eure from Tillières to Vernon; about 12,000 were en route to Châteaudun.

FRANCO-PRUSSIAN WAR—Continued

There was, however, little cohesion. Wittich had his forces well in hand, and successfully accomplished a number of reconnaissances in force. On Nov 3-4, Mocquard (stationed on the Eure) attempted a well planned surprise attack on Mantes, but it progressed too slowly and failed.

The French now attempted; but did not carry out, a junction between Fiereck's troops and the army of the Loire. Nov 9 Fiereck was directed to march against Chateaudun. It was too late. D'Aurelles had marched against, and was defeated at, Coulmiers.

The historical review undertaken by the General Staff had reached the above point when it was interrupted by the great war. The work was discontinued, and there is little hope of its completion.

—Railroads in

[German General Staff Railroad Concentration, 1870. By a General Staff Officer. *Military Historian and Economist,* Apr, '18. 13,000 words.]

Since 1870, the problem of mobilization and strategic concentration of the German army has greatly altered. The strength of the army has greatly increased and the number of railroads likewise. Notwithstanding the altered nature of the problem, a study of the concentration of 1870 is well worth while on account of the light it throws upon the use of railroads in war. This paper is compiled from the archives of the "Executive Commission," which is the leading element of the railroad concentration.

I. The Railroad System and Military Organization at the Opening of the War of 1870

The railroad system as it existed in 1870 had been developed mainly according to the needs of internal communication. Short-sighted views had limited the construction of railroads and particularly of important connecting lines. There was no single head, but the "Association of German Railroad Administrators" had established the rules most urgently necessary for the co-operation between different managements. The military organization of railroads for purposes of management had been fostered by the Prussian War Department since the beginning of railroad construction. Regulations were formulated and were ultimately adopted by all the German states, to become effective Jan 1, 1871. But the advent of war caused the immediate acceptance of these regulations.

The scheme adopted included a "Central Commission" in Berlin, with a special Executive Commission for the supervision and control of troop transports for the mobilization and concentration of the army. The Executive Commission also supervised and directed the military transports for army purposes in the interior and requisitioned foreign railroads, and for these purposes the commission was permanently attached to Royal Headquarters.

An assistant Executive Commission in Berlin helped out with the home railroads. Under the Executive Commission were Line Commissions to be established in case of mobilization. Line of Communication Headquarters were organized to control matters of entraining, subsistence, etc., of moving troops. After concentration had been completed, these were placed under the General Etappen Inspection of the army using the railroad. The railroad traffic was controlled by the Line Commission. Field Railroad Detachments for construction, repair, and destruction of railroads were organized under the General Etappen Inspection. Traffic in general was controlled by a Railroad Traffic Commission.

Bavaria had organized its railroad system on a military basis and formed its own Central Commission, Executive Commission, Line Commission, and Etappen Commissions. These commissions kept in close touch with the corresponding Prussian ones for necessary co-ordination. The rest of the non-Prussian railroad managements joined the North German or South German transport lines according to their location.

Based upon the military organization of the railroad system, the following officers and officials became active on the issue of mobilization orders on July 6, 1870:

1. Executive Commission for Troop Transports.
2. Line Commission for Mobilization Transports.
3. Line Commission for Troop Transports.
4. Etappen Headquarters.

(The complete details of these commissions, including the names of the officials, are given.)

II. Preparation of Mobilization Transports

In addition to the above general military organization of the railroads for war, the Prussian Great General Staff had made in peace time exhaustive preparations for the execution of military transport movements. First the troops had to be brought up to war strength, and this involved a considerable movement of men and animals from the depots. The conviction was gained that only by strict regulation could rapidity of mobilization be secured. Plans covering the regulation of interior transports by corps headquarters and thru transports by the Railroad Section of the Great General Staff were embodied in a mobilization scheme adopted in 1857. To govern thru transport, the North German railroad system was divided into three districts, and proper measures taken to insure the preparation of the necessary time-tables and schedules for transport movements in time of war. The mobilization transports were to be moved either with a schedule of passengers or mixed trains or with special trains, which were inserted in the peace-time time-tables.

III. The Movement of Mobilization Transports

No important demands were made on the railroads in the first few days of the mobilization. This time was utilized by the railroad managements in clearing the lines and depots and concentrating equipment where needed. After July 19 the military utilization of the railroads had to reach district headquarters, and then the assembled men and horses had to be transported to their organizations. These transports became very voluminous and covered long distances, as a number of regiments were garrisoned far from their recuiting districts. (Examples given.)

The mobilization transport did not exhaust the traffic resources of the railroads, but it had to be accomplished while preparations for large mass transports were un-

der way. There were cases of failure, but in the main the movements were properly handled.

(Follows a long list of telegrams quoted to show some of the break-downs which occurred. From this interchange of telegrams it is seen that the mobilization transportation did not take place without friction. Unforeseen circumstances entailed departures from fixed time-tables, and unexpected demands had to be met. More difficult was the forwarding of military transports whose schedules had not been arranged. The experiences prove that the orderly movement of transport can be counted on only so far as it is provided for in time of peace. Overloading a railroad merely decreases its efficiency.)

To prevent interference with mobilization by the French, the concentration of the troops on the frontier was ordered for points along the Rhine. Thanks to the excellent preparations of the General Staff, the mobilization on the whole took its course as planned. On July 26 the Line Commission of the Central District reported that the last reserve transport had departed, completing the work of the Line Commissions in North Germany. The same general condition obtained in South Germany. Bavarian railroads resumed passenger and freight traffic on July 25.

IV. Preparation for the Concentration Transports

The concentration of the army had been arranged in advance in all its details by the General Staff. The experience of 1866 was utilized. The recommendations of Major von Brandenstein, appointed Chief of the Railroad Section in 1868, were adopted as a basis for the military utilization of railroads; the regulations are still in force.

From the beginning of mobilizaton, the railroads are regarded merely as a means for war, and exclusively used for war purposes during concentration.

Until 1867 it was believed that concentration transport should commence only after mobilization transport was completed. But Major von Brandenstein proved that only about half of the rolling stock would serve mobilization needs, hence the concentration movements could commence before the mobilization movements were ended, and thus readiness for war hastened. He also pointed the way to hastening mobilization further by increasing the trains to 100 axles, and by adopting military time-tables and excluding all private traffic. The former meant a gain of almost a whole day in the transportation of each corps, but the latter measure was of much greater importance. Military time-tables had been worked out by 1870 arranging for a daily service of 18 trains per day on double track and 12 trains per day on single track roads. The standard speed was 14 miles per hour.

There were six lines of railroad available for the concentration of the North German corps, and three for the South German corps. The actual concentration of 1870 showed that the peace time calculations were exact and complete. Calculations showed certain transportation available for subsistence, but several days' rations were carried as a safeguard.

The peace preparations for the railroad concentration were completed with the working out of travel directions for the troops and railroad managements as well as travel and march tables for the different corps headquarters. The former had to be manifolded after mobilization. The latter were ready for immediate dispatch to the different corps headquarters.

FUSES

See also
PRIMERS

GAS MASKS

See
RESPIRATORS

GASES, ASPHYXIATING

See
ASPHYXIATING GASES

GENERAL STAFF

See
STAFF—GENERAL STAFF

GEOGRAPHY, Military

—Climate

See
CLIMATE, MILITARY ASPECTS OF

GERMANY

—Aeronautics

See
AERONAUTICS—GERMANY
AERONAUTICS—ORGANIZATION AND ADMINISTRATION (Article: "Air Power—Organization of Flying Troops")
AERONAUTICS—MATERIEL—GERMANY
RUMPLER BIPLANE

—Army

See also
ATTACK
EUROPEAN WAR—FORCES ENGAGED—GERMANY
EUROPEAN WAR—WESTERN THEATER (Article: "Impression of a Visit to the German Front in Belgium")
MORALE (Article: "Comparison and Conclusion")

—Army—Artillery

See also
ARTILLERY—MATERIEL (Article: "The German Long Range Gun")
ARTILLERY—MATERIEL—GERMANY
EUROPEAN WAR—LOSSES—ARTILLERY

—Army—Cavalry

See also
CAVALRY—ORGANIZATION—GERMANY

—Army—Infantry

See
INFANTRY—ORGANIZATION—GERMANY

—Army—Mobilization

[The German Mobilization in 1914. By V. ***Mem. de Ingenieros***, Sept, '18. 3000 words.]

(A detailed statement of the method of numerical designation employed in the German Army prior to the present world war. Not believed to be of general

GERMANY—Continued

interest as it is not so arranged that it would be of value in identifying prisoners.)

—Army—Supply and Transport

See

SUPPLY AND TRANSPORT—GERMANY

—History

See also

EUROPEAN WAR

FRANCO-PRUSSIAN WAR

—Military Policy of

See also

EUROPEAN WAR—MILITARY LESSONS OF THE (Article: "Deductions from the World War")

EUROPEAN WAR—GENERAL NOTES ON OPERATIONS, BY THEATERS—WESTERN THEATER (Article: "The Crisis")

[Issues of the World War: The Menace of Mitteleuropa. By T. F. A. Smith. *Army & Navy Gazette,* Aug 17, '18. 2200 words.]

There are two wars going on against the enemy, the immediate war of arms and economics and the future war of political constellations. If Germany wins the second, the ultimate results will be the same, whether she loses the first or not. She wants to be in a position to dictate to the powers and "Mitteleuropa" is the solution, to her, of such a problem. The plan is quite clear. It means the establishment of a huge land block extending from the Baltic and the North Sea to the Mediterranean and Indian Ocean, the whole to be under German direction and domination for offensive and defensive economic, political and military warfare. By such a position of strength on land, she hopes to neutralize hostile sea power and dominate foreign affairs by European control.

—Navy

See also

SUBMARINES—GERMANY

GREAT BRITAIN

—Aeronautics

See

AERONAUTICS—GREAT BRITAIN

AERONAUTICS—INSTRUCTION AND TRAINING—GREAT BRITAIN

AERONAUTICS—MATERIEL—GREAT BRITAIN

AERONAUTICS—ORGANIZATION AND ADMINISTRATION (Article: "Air Power—Organization of Flying Troops")

—Army

[That Contemptible Little Army. *Independent,* Jan 26, '18. 250 words.]

During the war the total enrollment of the British army and navy has been 7,500,000 of whom England has contributed 4,530,000, Scotland 620,000, Wales 280,000, Ireland 170,000 and the overseas dominions and colonies 900,000.

See also

EUROPEAN WAR—LOSSES—GREAT BRITAIN

[The Irish Troops in the Service of Spain, 1709-1818. By Prof. C. Oman. *Jour. Royal United Service Institution,* May, '18. 3500 words.]

(Historical. Part II, 1742-1792. During this period the Irish contingent comprised three regiments, Hibernia, Ultonia, and Irlanda, constituting the Irish Brigade. They served conspicuously in the various wars in which Spain was engaged, and in overseas expeditions and garrison duty. By the close of the period, the regiments had been depleted in strength and were finally combined with other foreign contingents, thus losing their essentially Irish character.)

—Army—Artillery

See also

EUROPEAN WAR—LOSSES—ARTILLERY—GREAT BRITAIN

FIELD ARTILLERY—MATERIEL—GREAT BRITAIN

—Army—Cavalry

See also

CAVALRY—USE OF IN EUROPEAN WAR

—Army—Infantry

See

INFANTRY—INSTRUCTION AND TRAINING—GREAT BRITAIN

—Army—Organization

See also

INDIA—ARMY—ORGANIZATION

[Personnel. By Major-General R. Hutchinson, C.B., D.S.O., Director of Organization, British Army. *Infantry Jour.,* July, '18. 5500 words]

One of the greatest changes in the British Army since the war began is in the way in which the question of personnel is handled. During 1915, when Lord Kitchener was expanding the regular army, there were all kinds of skilled mechanics, university graduates, laborers, politicians—in fact all kinds of men serving in infantry formations.

Soon there existed a shortage of the necessary type of men for the engineer and repair units of the army. Shipyards, coal fields and collieries also lacked properly trained men and their outputs were reduced.

In 1916, when conscription was adopted, the same mistakes were made. Men were placed in the army without regard to what they had been doing in civil life. Towards the end of 1916, the bad effects of this policy were very apparent. The men required for munition factories, shipbuilding, Royal Engineer units, and railway work could not be supplied.

The General Staff stated the case to the Adjutant General, but it is very hard to take men from fighting organizations and return them to an industry at home. After many efforts a machine to accomplish this reorganization was started and was known as the Department of Organization. Many obstacles were encountered, but after the officers began to appreciate the necessity for the reorganization there were returned to their former occupations between thirty and forty thousand shipbuilders and about seventy thousand agricultural experts. These men were all fit soldiers

and the effect on the various divisional and corps commanders can be imagined.

Among the obstacles met by the Department of Organization was that men were ordered to overseas service just about the time the order transferring them because of their qualifications, was issued. These men had to be searched out again. Battalion commanders were often reluctant to give up these trained men, because they were usually good soldiers. It became necessary to start a great index system, a system similar to the one in use in the United States Army. A man is recorded on a card which shows his organization, prior profession, his home, etc. This index system shows that men are properly located and the total number of men in the country. Returns showing the information required by the Department of Organization were hard to get from many units. So many returns were required by all the departments that after consultation with the General Staff, the Quartermaster's Staff, the Ordnance, the Adjutant General's Office, and all other departments, a "consolidated return" was decided upon. This return was received in the office of the Director of Organization, and from there the parts of the return were torn off and fowarded to the various departments.

The importance of the personnel branch of any country cannot be overestimated. The machinery of that branch must have but one man at the head. Success depends upon the proper use of a country's man-power, and it is the personnel branch which places the men where they are most useful. The personnel officers must try to make all officers see the necessity for this personnel work and impress upon all the importance that the General Staff attaches to this work.

[Impressions of a Visit to the British and French Armies in France. By Patricio Prieto. *La Guerra y su Preparación,* Mar, '18. 12,000 words. Conclusion of article in February issue.]

Motor Traction—Tanks

Besides applying mechanical transport to field artillery pieces, the Allies have also applied it to food and ammunition columns, moving of personnel, ambulances, light autos for official trips of officers and dispatch bearers, armored cars and armed cars, repair cars, telegraph cars, cook cars, cars for medical purposes of all sorts.

In England, the organization of mechanical transport started after the Boer War. At the beginning of the present war England had a reserve of motor drivers, and upon this reserve, which accompanied the original expeditionary force, was built the present Army Service Corps which has charge of all land transportation.

Early in the war the English found their supply of motor cars and trucks entirely inadequate, so recourse was had to the London busses which were all requisitioned as well as private cars and trucks. Later the demand became so great that great numbers of chassis had to be purchased in America by the British.

During my brief visit to the British front, I noted the number 36,567 as being the highest number on any motor truck. This would indicate that there are at least that number of trucks in the zone of operations in France.

The usual type of motor truck carries a useful load of four tons, limited to three tons by order. There are a few steam trucks in use. The following types are in the greatest proportions: Daimler, Comemcar, A. E., Leyland, Dennis, Albion, Wolseley, Thornycroft, Napier, L. G. O. C., Haldford, Halley, National, C. P. Co., and Belsize.

Trucks bear marks indicating their use, *i.e.*, an ammunition truck has a projectile of the caliber it carries painted on the outside, a truck attached to Cavalry Division Headquarters is marked with a horseshoe.

With the increase in motor transport it was found necessary to establish a large receiving depot in the addition of a second depot in the west of London with a capacity of 3000 cars. The personnel of the London Omnibus Co. was used to train the new chauffeurs at the rate of from 1500 to 2000 at a time. The variety of types increased the repair difficulties, so that finally the Ministry of Munitions built three great storehouses for spare parts and one for rubber tires.

Outside of London and on the Continent other repair centers were organized, either as advanced repair depots or base repair depots. At these depots were placed a reserve of trucks equal in number to 10 per cent of the number actually in use. This reserve was later reduced to 3 per cent of the number in use. All the equipment of these depots is provided by the Army Ordnance Department.

Auto ambulances did not exist in any great quantity before the war. Five weeks after England had become engaged, the English Automobile Club had placed all its cars at the disposal of the Red Cross. The London *Times* in three weeks provided 512 ambulances by popular subscription. By the end of January, 1915, the Red Cross had sent 446 ambulances out of England, and the Order of St. John had also been supplied. By the end of 1915 there were 650 Red Cross ambulances in France, and by the end of 1916 this number had been increased to 2500. The government had created numerous convoys of 50 ambulances besides the necessary repair cars, store cars, etc., and motorcycles.

The type of ambulance made regulation by the Ministry carries four bed patients, two on each side of the car one above the other, or eight sitting or standing patients. These ambulances are artificially heated by making use of the exhaust gases for this purpose.

Other Arms and Services

The organic tactical unit of the British infantry is the battalion: the regiment is simply an administrative unit. The increase in the British infantry has not been done by increasing the number of regiments, but by using the old battalions for nuclei upon which to build new ones. Some of the present English regiments contain as many as thirty battalions. Each battalion consists of four companies of 250 men each. Of these men, sixteen are armed with the Lewis automatic rifle and sixteen are armed with hand grenades and are classed as grenadiers. Each battalion of infantry has two 7.6 cm. trench mortars. The machine gun units are organic parts of the infantry brigade. Each ma-

GERMANY—Continued

chine gun company is equipped with eight Vickers-Maxim guns. My visit to the infantry school of the Third British Army has convinced me that the British Army possesses the qualities of the best organized, armed, and instructed infantry in any army.

The cavalry is equipped with the Hotchkiss machine gun, which is packed on mules or horses.

The transport service in the charge of the Army Service Corps gave the impression of an abundance of resources, excellent organization, and well ordered functioning. Mile after mile of transport columns were observed on the roads without any confusion, noise, or blocking of the road being evident. All roads are plainly marked indicating what sort of transport may use them and in which direction transport columns may move. Crossroads are amply provided with full directions for transport columns and troops.

Immense bases such as Calais and Boulogne have been established on the French coast at which supplies and troops are received from the outside and from which supplies and troops are shipped into the zone of operations to sub-bases over canals, railroads and roads, and from which the sick, wounded, and men on leave are embarked for England. These bases are admirably organized. In both Boulogne and Calais large repair shops for equipment and clothes have been established, under direction of the Army Ordnance Corps, in which 1000 soldiers and 2000 women are employed. Most of the work is done by machinery which has been very abundantly supplied and efficiently installed. The repair of field pieces and artillery matériel is done to a certain extent on the Continent, but the majority of this work has to be done at the Woolwich Arsenal.

As to the General Staff work: In all staff work the contoured map on the scale of 1:40,000 is used most extensively. These maps are contoured with a vertical interval of 10 meters, and in some cases of 20 meters.

On the part of the map corresponding to the advanced sectors occupied by the enemy are marked his daily positions with detailed locations of his various units and the Allied units, showing the trenches they occupy, and showing the positions of brigade and higher headquarters.

There is a map issued in the scale of 1:100,000 with a vertical interval of 10 meters in colors and divided into squares of 5′ latitude and 5′ longitude which covers all of Belgium and the north of France in nineteen charts. These 5′ squares are lettered horizontally from "A" to "L" inclusive on each chart.

Other maps are issued on a scale of 1:10,000 and 1:20,000, of which the latter are most universally used. These maps are used for correction of artillery fire and for indicating the two trench systems, as well as for planning and following the development of engagements. Profiles of the German trench system and of the battle zone occupied by the Germans are also made and used in determining the feasibility of artillery fire against certain points, and the type of gun which can be used most effectively. At Great Hdqrs. of the British Army, the entire Hindenburg line is profiled on 11 sheets showing a marked tendency on the part of the Germans to occupy intrenched positions which are protected to the rear by high ground.

One of the branches of the General Staff which is of great importance is the Intelligence Service, which collects all information dealing with enemy strength, position of various enemy units, and of his headquarters, movement of forces, plans of operations, data concerning material, and state of morale of enemy troops.

General Impressions of British Army

Outside of special troops for duty in India, Egypt, South Africa, Canada and Australia, and taking into consideration the "Metropolitan" and Colonial Army, the British Regular Army consisted of 152,251 men on Jan 1, 1913, divided as follows:

157 battalions of infantry; 31 regiments of cavalry; 25 horse batteries; 114 mounted batteries; 21 howitzer batteries; 12 heavy artillery batteries; 12 reserve and 9 mountain (active) batteries; 86 companies of coast artillery, and 77 companies of engineers.

By the end of August, 1917, the English fighting force was 150 kms. long, extending from the northwest of Ypres to the Ham-St. Quentin Road. This front was covered by over 2,000,000 men. The force was divided into five armies, two cavalry corps, the necessary Headquarters staff and the employees at the ports of debarkation. The organization of each Field Army is as follows: Four army corps of three solid divisions, of three brigades ,of four battalions of four companies.

Visit to the French Army

The fronts occupied by the French near Lassigny and Noyon and Coucy-le-Château were all visited. There was no time in which to make detailed observations. Observation was taken of artillery emplacements which in many cases were very temporary in character. Characteristics of some of the pieces are all shown in the table:

	10.5 cm. Cannon	15.5 cm. Cannon	15.0 and 15.5 cm. Howitzer	22 cm. Mortar	28 cm. Mortar
Weight of projectile, kilograms	16.4	43	40	100	205 and 275
Initial velocity, meters per sec..	570	600	380	350	394 and 315
Length in calibers	28.4			9.3	12.0
Weight of piece in battery, kilograms	2270	5525	3000	6180	14,916
Kind of traction	Animal	Mechanical	Same	Same	Same
Number of vehicles	1	2	1	2	5
Weight of the gun carriage, kilos	2600	8580	3500	3710	5250
" " " trail, "		4200		4300	4695
" " " cradle, "					5230
" " " "explanada" "					5422
" " " gun carriage with accessories					4950
Has it a shield?	Yes	Yes	Yes	Yes	Yes
Is it equipped with metallic pole	Yes	Yes	Yes	No	No
	Cannon	Cannon	Howitzer	Mortar	Mortar

Before the war, each army corps was assigned regiments of nine batteries of four pieces each as divisional artillery, besides twelve batteries of four guns

as corps artillery. The divisional artillery has remained the same, but the corps artillery has been reduced to six batteries.

The battery organization remains the same as before the war—four guns and twelve ammunition carts.

French artillery is distributed as follows: six 15 cm. guns to division, six 5.8 guns to division, and one 7.5 cm. gun per battalion.

Heavy and medium heavy artillery are assigned to army corps and field armies. The medium calibers are divided into four-gun batteries, which are in turn combined into groups of varying strength, depending on the tactical situation at any point where they are being used.

Anti-aircraft artillery is usually 75 mm. caliber and on special mounts. Ammunition supply for artillery is carried out by truck trains and by horse and mule transport. Ammunition columns of divisions and army corps use animal traction.

The ammunition for artillery is divided into two general classes—explosive projectiles, and high explosive shrapnel.

The explosive charges usually consist of melinite, trinitrotoluol, ammonal, and schneiderite.

General Observations

It is well to call attention to the great diversity of calibers in the artilleries of England and France. This is due to the fact that neither has had any settled artillery policy, but developed various guns as they were needed and as experiments towards a general utility caliber. One noticeable feature of this diversity of caliber is the lack of confusion in munition supply which one would naturally look for. In neither the French nor British Army does it exist.

The English medium and large calibered guns are not equipped with shields, in direct contrast with the French guns, which have very efficient shields. It is merely a question as to whether or not the protection offered by a gun shield for the medium and heavy calibers is of enough value to offset the transportation difficulties due to weight of the shield. The French guns are in my opinion the best.

In the German Army heavy artillery was used originally to destroy fortified points and to open up lines of communication swept by enemy fire. Now the heavy artillery is used to prepare the way for the infantry assault and in this task it is used with the 77 mm. field gun. In this work of preparation each caliber of heavy gun is assigned to a certain type of target, depending upon the nature of the target—whether it is moving or stationary, matériel, personnel, fortified, or not fortified.

The French regulations state that the heavy calibered guns can be used against strong constructions which are non-inflammable, and against fortifications. These guns are effective in producing a moral and material effect in a certain well defined zone at any given instant. The French 75 mm. field gun can take care of the ordinary battlefield targets that may present themselves.

The English regulations state that heavy artillery should be used where the best advantage can be taken of its great accuracy, long range, and destructive power, taking into account its poor mobility.

[The Army After the War. By "Clericus." *Journal of the Royal United Service Institution*, Aug, '18. 3300 words.]

With its vast army drawn from every colony, as well as from the British Isles proper, Great Britain is now interested in the disposition of this force after the cessation of hostilities when it will no longer be needed for field service. Practically all are agreed that Great Britain must and will have a large military force for her future protection and for the enforcement of the terms of peace that will follow the actual conflict. The present question now is what can she decide upon so as to be able to make the most of her present trained army to organize it on a successful basis.

The two favorite alternatives are a large standing Regular Army, or a National Guard system such as existed in the United States prior to the present war. This proposed project is not to include the Royal Air Force or the Royal Navy, both of which are separate branches of the service and would not come under the military program.

The author proposes the following solution of the problem:

Have compulsory military service for all able-bodied males between the ages of 16 and 40. In this way a man would put in 24 years of military service divided as follows:

(a) Service as cadets in cadet units for 2 years, or until the age of 18.

(b) Service in a Regular Army on a permanent basis for 12 years, this period to be divided into Color service and Reserve service varying with the arm of the service to which attached. This service to be by voluntary enlistment. In case the candidate did not wish to adopt this course, the only other alternative open was that of being compulsorily drafted into the Territorial Army for two years' continuous training at the age of 20.

(c) Service in a Territorial Army, comprising a short term of continuous service followed by periods of training at stated intervals. This to be between the ages of 20 and 30. Training to be one month annually for the first four years, and one month biennially for the last 6 years.

(d) Service in a Reserve, formed from the effectives of the Permanent Army, whose service with the colors had expired. These would be known as the Permanent Army First Reserve, or P. A. Reserve, Class I. The training for this army would be one month biennially. From the ages 30 to 40, men in this Reserve would pass to a Second Reserve, or P. A. Reserve, Class II.

(e) Service in a Reserve formed by the Territorial Army. The training during this period to consist of obligatory short "refresher" courses at stated intervals, depending on the branch of the service to which a man belonged. It is suggested by the author that this training be voluntary, instead of compulsory, and that some form of compensation be offered as an inducement to make it voluntary.

It is to be the understanding that any of the troops

GERMANY—Continued

thus raised would be available for service anywhere within or without the United Kingdom, unless actually undergoing training. It is projected that there will be a number of officers and non-commissioned officers in the fighting forces of Great Britain now who will wish to retain their commissions after the war, and it is this class of men upon whom this plan must depend for leaders and instructors.

Cadet companies would be approximately 150 strong and be organized into battalions. They would either be housed in barracks or public buildings, or else live at their homes, if conveniently located.

The following organization is proposed for the Permanent Army:

(a) A *Field Army* organized into corps, divisions, brigades, etc., with cavalry divisions, corps and divisional troops and of communication troops in addition.

(b) *Garrisons* for coast defense, consisting partly of regular garrison, heavy and anti-aircraft artillery, engineers and infantry, and partly of Territorial troops of these arms with cyclists in addition.

(c) *Recruit depots* for all arms which would receive and train the recruits for 6 months and then pass them on to the cadres of (a) and (b), above.

The Field Army would consist of

(a) Two cavalry divisions of 3 brigades each.

(b) The Home Commands and London District to provide one army corps, viz.:

Aldershot	Command	4	divisions
Eastern	"	4	"
Irish	"	3	"
Northern	"	3	"
Scottish	"	2	"
Southern	"	2	"
Western	"	2	"

London District, 1 Guards Division, and the Household Cavalry Brigade.

This would make in all a total of 20 divisions, exclusive of the Guards Corps. Maneuvers for this army to be held in the summer or fall months.

The sources from which officers could be drawn are as follows:

For the Permanent Army—

(a) From the gentlemen cadets of the R.M.A. and R.M.C., after passing thru a two years' curriculum there from 16 to 18 years of age.

(b) From the ranks of the P.A.

(c) From the selected cadets of cadet units after attaining 18 years of age.

For the Territorial Army—

(a) From the ranks of both the P.A. and T.A.

(b) Same as (c), above.

If such a scheme be adopted in the colonies as well as in Great Britain, the writer points out that it will reduce the time of foreign service of units now serving abroad to five years, as well as standardize the training of all the British forces.

In addition to the above, the author advocates the retention of such organizations as the Women's Army Auxiliary Corps, and various cadet and welfare organizations, as all being in sympathy and co-operation with the plan he has suggested.

—Compulsory Military Service

See also

GREAT BRITAIN—MILITARY POLICY OF

—Expeditionary Forme for European War

See also

EUROPEAN WAR—LOSSES—GREAT BRITAIN

—History

See also

CANUTE THE GREAT

EUROPEAN WAR

[Anglo-French Relations. By Maj.-Gen. T. F. Lloyd. Chapter 35, continued. *United Service Mag.*, Mar, '18. 6700 words.]

(Historical serial. This installment covers the trial and execution of Joan of Arc.)

[The Personnel of the Tudor Navy and the Internal Economy of the Ships. By Captain C. S. Goldingham, R.M.L.I. *United Service Mag.*, Mar, '18. 13,000 words. Tables.]

(Historical.)

[Anglo-French Relations. By Maj.-Gen. T. F. Lloyd. *United Service Mag.*, Apr, '18. 4000 words. Chapter XXXVI.]

(Historical serial. This installment covers the period immediately following the execution of Joan of Arc.)

[Anglo-French Relations. By Maj.-Gen. T. F. Lloyd. *United Service Mag.*, May, '18. 8500 words.]

(Historical. Chapter 37 of a continued article.)

[Anglo-French Relations. By Maj.-Gen. T. F. Lloyd. *United Service Mag.*, June, '18. 3000 words.]

(Historical serial. The present installment is Chapter XXXVIII, and covers the period from 1433 to 1435.)

—Military Policy of

[Some Principles of Military Reconstruction. By "Rooinek." *United Service Mag.*, Oct, '17. 3200 words.]

At first thought it might appear absurd to attempt at this time a discussion of the reconstruction of the British military forces. No army in history ever underwent such a change as has the British Army during the past three years. Not only has it been increased in size twenty or thirty-fold but it has been born again. What Great Britain has now, however, is but a temporary army, improvised to meet a special emergency. When that emergency has passed the army must be reconstructed.

It would be neither practicable nor expedient to revert to the pre-war system of a small long-service professional army, of which roughly two-thirds were permanently retained in the British Isles, backed by about twice as many Territorials with only slight training—all being raised by voluntary enlistment. The old Regular Army has been practically swept out of existence. The professional soldier class has ceased

to exist in its entity. Those few remaining have been swallowed up in the vast citizen armies. Continuity has been broken; and continuity once broken is always difficult to rejoin. It is probable that the people will be so war-weary that it will be impossible to recruit volunteers to fill the ranks in any event.

Some system must be devised by which the overseas garrisons may be maintained. For this service volunteers must be obtained. For the forces at home, however, the old system will not do. It was expensive and economy will be essential after the close of the war. Sufficient volunteers could scarcely be secured when the prospective needs of the labor market are considered. Strongest reason of all, a Regular Army of the size maintained before the war is not big enough for the demands of modern war.

Tho the old system must be abandoned, it is inconceivable that England would undertake the tremendous burden of armament such as has oppressed Europe for the past fifty years. The Swiss or Norwegian systems offer a way out of the difficulty. They are both democratic and cheap. The close of the war will offer a most excellent opportunity to establish such a system on a firm basis. A considerable permanent staff of officers, non-commissioned officers, etc., would be needed. From the veteran armies returning home there should be no difficulty in obtaining these. All the knowledge and experience these armies have gained must not be allowed to go to waste. Rather it must be handed on to succeeding generations.

To be effective the "Metropolitan Army" should fulfill the following conditions:

(1) It must be liable for foreign service in time of war should Parliament so decide.

(2) It must be of sufficient strength to render such intervention effective.

(3) It must be capable of rapid mobilization with all its parts and materials.

(4) It must be sufficiently well officered and well trained to contend with chances of success against any potential enemy in equal numbers.

Two facts stand out. That it will be impossible to disarm in the midst of an armed Europe, and that Imperial security cannot be neglected. These problems will have to be faced. Tho Great Britain may be too fully occupied at the present moment to give them the attention they deserve, they should not be wholly neglected.

[Great Britain's Man Power. *Army and Navy Journal*, Jan 19, '18. 900 words]

Sir Auckland Geddes, Minister of National Service, made a long, interesting statement in the British House of Commons on Jan 14 concerning Great Britain's man power program. The immediate problem before Great Britain was stated to be the raising of a minimum of about 450,000 men. The program adopted by the government is the result of a consideration of the three possible changes in the present military system. The first of these possibilities is the lowering of the age limit. While Germany is taking boys of seventeen, this solution has been rejected by the British government as economically unsound and contrary to natural instincts. A second possibility is raising the age limit. Tho the British limit is forty-three years as compared to the Austrian fifty-five, such a step was felt to be contrary to the national interests so long as there was a considerable body of younger men fit for service. A third measure which might be employed would be compulsion for Ireland. It was decided that the reasons which had excluded Ireland from the first compulsory service act had lost none of their potency.

The other possible course, and that adopted by the government, is the selection of young men engaged in essential industries. More than 1,000,000 men are now exempted on occupational grounds. The government has divided the essential industries into three classes. From the first no men will be taken; from the second about half of the fit men, and from the third about one-third. Steps will be taken to maintain the industries after the young men are withdrawn.

Referring to what Great Britain has already done in the way of assembling man power for the war it was stated that the naval personnel has expanded from 150,000 to 400,000. The army now has more than 4,000,000 men on the rolls. The combined air service has increased from 2000 to 125,000. The total enrollment in the British armed forces has been 7,500,000. Of these England has contributed 4,530,000, Scotland 620,000, Wales 280,000, Ireland 170,000, the dominions and colonies 900,000. The remaining 1,000,000, consisting of native fighting troops, labor corps, carriers, and similar workers, were from India, Africa and other dependencies. Excluding Ireland, the United Kingdom has given about thirteen per cent of her population to the army and navy.

[British Army Organization. *Jour. Royal United Service Institution*, May, '18. 7500 words.]

The paper is divided under three headings: A, Past Experience; B, Present Conditions; C, Future Needs. A and B are summarized by certain "conclusions," and upon these the "deductions" made in C are based.

Amongst those in A are: 4th. So far as can be predicted, wars will occur in the twentieth or twenty-first centuries with as great regularity as they have done since the first. 5th. The old maxim holds true—*Si vis pacem, para bellum.* 6th. The maintenance during peace of an army is essential, ready at the shortest notice and in sufficient strength for war. 9th. No sound organization is possible without the assurace beforehand of adequate means. 10th. That assurance cannot be provided by a voluntary system alone. 11th. It can only be supplied by the acquiescence of the whole nation, determined that all shall do their fair share.

Amongst those in B are: 1st. The army is composed of differently organized units (Regulars, Special Reserve, *i.e.*, the old Militia, Yeomanry, Territorials, *i.e.*, the old Volunteers, and the "New Army"). 2nd. The pay of all ranks is notoriously inadequate. A few "considerations" are appended, showing that a national service need not entail (a) unnecessary interference with industry, or (b) "the presence with the colors of

GERMANY—Continued

a tremendous number of men," (c) Compulsion has for years been enforced, *e.g.*, in the matter of education, with admittedly beneficial results.

Part C assumes the correctness of the conclusions reached in A 7-11. It urges increased care by the state for youth. Present arrangements are (a) compulsory education up to 14 years of age, (b) optional after 14, and (c) from 18 years onward practically *nil*. The new Education Bill extends the ages for compulsory education and provides for better physical training. These are steps in the right direction. Their amplification is pressed. For lads up to 14, each school should have its company or companies, grouped in battalions. Friendly rivalry should be encouraged by every possible means. Each battalion should be affiliated to its county regiment. "Both ther egiment and the boys would be delighted, and each would be of valued use to the other." On leaving school at 14, a lad will henceforward attend continuation classes till he is 18. Cadet battalions should be formed of these, and he should pass from his school to its cadet battalion. Lads' Brigades, Scouts, etc., should be recognized and assisted by the state, and also be affiliated to the county regiment. At 18, a lad should join his county regiment. He could elect either for the Regulars or the Reserve. In the former case, he could enlist for a fixed term of service as at present; in the latter, he would undergo a short training and then be dismissed. There should be no exemptions except on the grounds of physical unfitness certified by a board of military medical officers. The regulars might be recruited by voluntary enlistment, any deficiency in the annual supply being made good by ballot from amongst those who had elected the Reserve. Men so taken to have an early opportunity of claiming their discharge if they wished, provided that the establishment was not thereby depleted.

With regard to the Reserve, the claims of civil occupation are taken as not "particularly pressing up to the age of 25 or even 30. After 35, the physical condition of a soldier begins to deteriorate under the exacting conditions of modern war, while his value to the nation in his profession increases." A graduated scheme is accordingly suggested for subsequent trainings. (1) From 19 to 30, one month's training every third year. (2) From 31 to 40, two weeks' training every third year. (3) From 41 to 50, men to join a Volunteer Corps. (1) would form the First Class Reserve, liable to first call upon their services; (2) the Second Class Reserve, only liable after the First Class had been called up; (3) would be liable for Home Defense alone. All passed as physically unfit for (1) and (2) could be transferred to (3).

Various suggestions are made for unifying pay. "Such measures would simplify organization. Instead of having Regulars, Special Reserves, Territorials, or periodical New Armies to deal with, the whole would be included in (1) Regulars and (2) Reserves." A further simplification in pay would ensue. Several other advantages are claimed.

—Naval Policy of

[British Freedom of the Seas. An Historical Retrospect. By T. Miller Maguire, M.A., LL.D. *United Service Mag.*, Apr, '18. 5300 words]

(Historical discussion of the policy of Great Britain with respect to freedom of the seas.)

—Navy

See also

PENN, ADMIRAL SIR WILLIAM

PIRACY—SUPPRESSION OF

[The Navy and the War. By "Admiral." *United Service Magazine*, Sept, '18. 5500 words.]

Altho the British Navy is not represented on the War Council, its work in the war is of prime importance. In addition to the recent exploits of bottling up Ostend and Zeebrugge, it has kept the seas open to transport over one and a quarter million American troops to France, in spite of the enemy boast that *all* American transports would be sunk. The German Admiral von Capelle estimates that every American soldier landed requires 7 tons of transport for his supply. This is denied by the British Admiralty who claim 5 tons sufficient.

From a tonnage of 2,500,000 tons in 1914, there has been an increase in the British Navy to over 8,000,000 tons, which requires 1,500,000 men of the mercantile marine, half of whom are of military age.

German submarine losses are placed at 150, half of which were destroyed within the past year. This as compared with 360, the gross number of submersibles constructed by Germany, shows that 40 per cent have been destroyed, and she has still 200 available for use against Allied shipping.

Mr. Lloyd George announced that since the "great push" of Mar 21, 1918, over 355,000 men were transported from England to France in defiance of the submarine menace, as well as demonstrating to the enemy that British man-power was not exhausted, as he claimed.

To show that the decrease in losses was not due to any lack of targets presented to submarines, the Admiralty figures for the end of the quarter ending June 30, 1918, show a greater number of vessels entering and clearing ports of the British Isles. For this same quarter last year British losses were 1,361,870 tons, whereas for the same quarter this year they have been reduced to 614,818 tons. The world losses for the above peiod were 2,236,934 tons and 946,570 tons respectively. Thus with 22¼ million tons of shipping a quarter plying British ports, the von Capelle boast of starving England can hardly be maintained, especially since monthly losses have fallen from 900,000 tons to less than 300,000 tons.

Total losses and replacements from the beginning of the war up to the end of 1917 are as follows:

	Tons		Tons
World losses ...	4,748,000	British losses ...	7,079,000
World gains	5,383,000	British gains ...	3,811,000
Net gain	635,000	Net loss	3,268,000

Further losses since the beginning of 1918 bring the net British loss to 3¾ million tons.

The following reasons are advanced by Lord Pirie for the short output to replace British losses:

1. Lack of skilled men due to enlistments early in the war.
2. Construction of special types of warships required 25 per cent more labor, which was taken from labor devoted to merchant ships.
3. Heavy repairs and refits for both mercantile and naval vessels.
4. Special types of cargo vessels for the navy which required more labor than ordinary merchant cargo vessels.

To improve the present facilities and increase the output, Lord Pirie announces the construction of 87 new berths, the lengthening of 24 existing slips, and the construction of 102 berths for concrete ships. The program calls for concrete, standard and fabricated ships.

—Navy—Losses

[Losses in Naval War. By Percival A. Hislam. *United Service Mag.*, Apr, '18. 6600 words. 5 tables.]

Naval losses are accepted by the country in a different spirit from that in which military losses are received. Thus military losses exceeding 27,000 incurred last November gave rise to no comment, yet it was broadly hinted that Lord Jellicoe was relieved as First Sea Lord more or less directly as the result of the loss of three destroyers and fewer than 200 lives on the 22nd of December in the North Sea. Yet it should be apparent that victory at sea is no more possible without risks and losses than victory on land.

Naval losses have undergone a change compared with former times on account of present methods of construction and new forms of attack. These render the present-day naval vessels liable to become complete losses by sinking, whereas formerly only damage resulted. Thus the *Good Hope* and *Monmouth* were lost with all on board, and over 1400 lives were lost when the *Aboukir, Cressy,* and *Hogue* were sunk. It is stated that the combined losses of both sides in the naval campaigns of the Russo-Japanese War were only 1883 killed and 1809 wounded, but there is doubt as to the accuracy of the figures.

The changed conditions are most vividly shown by the fact that the total loss in killed in five of the greatest British naval engagements—June 1, 1794, St. Vincent, Camperdown, Nile, and Trafalgar—did not exceed by more than a hundred the loss of life involved in the destruction of the battle-cruiser *Queen Mary* in the Jutland action. In the sea fights of former times the wounded outnumbered the killed, but in modern engagements the proportion of killed is much greater, as a wounded man has little chance of being saved from a doomed ship.

Analyzing the losses in armored ships of the British navy down to Feb 23, 1918, it is noted that 14 were sunk by submarnes, 7 by mines, and 10 by gun fire, while 3 were destroyed by internal explosion, 1 was topedoed by a surface ship, and one was wrecked. Under water attack thus accounted for 21 out of 36 vessels, being slightly more than half of the destroyed tonnage. There is still doubt, however, as to the cause of the sinking of the *Hampshire* [in which Lord Kitchener was lost—Ed.], and as to whether the *Irresistible* and *Ocean* were destroyed by mines or torpedoes. The bulk of the loss by gun fire above noted occurred in the Jutland action. Inclusion of other classes than armored vessels would considerably change the proportions of losses from the enumerated causes.

In considering the question of attacking at the Dardanelles, the War Council was advised by Lord Fisher that probably twelve battleships would be lost in the attack. After being so advised, the War Council decided on the attack, but abruptly stopped the purely naval part of it as soon as three vessels had been lost. Civilians fail to appreciate the fact that success cannot be achieved without paying the price. The blame for stopping the naval attack has been placed on the public, but civilian officials ought to know how the public will be affected.

A notable feature of the present war has been the steady increase in the number of destroyers lost. By half-yearly periods beginning in August, 1914, the number lost have been 1, 3, 3, 11, 6, 12, and 15. The eleven vessels sunk in the fourth period included the losses in the Jutland action. Even including these, there were more destroyers lost in the last year (ending January, 1918) than in the preceding 2½ years. This increase in losses has been due to the fact that there at least twice as many destroyers in service now as at the beginning of the war, and greater risks are taken. Meanwhile the destruction of enemy U-boats has increased in much greater ratio. It is stated that the rate of destruction of U-boats was four times as great at the end of 1917 as it had been in the previous year.

There is also an increase in the number of war vessels lost. There is a distinct and direct connection between the increased losses of war vessels thru underwater attack, the growing success of the U-boat campaign, and the reduction in the rate of loss of British merchant ships. The convoy system, brought into use in the early half of 1917, shifts the risk from the merchantmen to the war vessels.

(Follows a discussion of the subject of tonnage losses due to U-boat operations.)

GREECE

—History

See also

Balkan wars
European war

GRENADES

See also

Primers (Article: "Primers for Explosive Grenades")

—Rifle Grenades

[Rifle Grenades. By H. Gunther. *Schweiz. Monatschrift aller Waffen*, July, '17. 1150 words. 3 figures.]

The rifle grenade was developed because of the desire to increase the 40 meter range of the hand grenade. The first rifle grenades were invented in Berlin in 1668. Their range was 200 paces. These had no practical

GRENADES—Continued

success. Rifle grenades were first used successfully by the Russians at the siege of Port Arthur. This type, invented by Captain Sselensky, had a cast iron body filled with explosive, with openings at each end. In one opening was inserted a steel rod which fitted into the muzzle of the rifle, which was loaded with a blank cartridge. The trajectory of the grenade was similar to that of a mortar projectile. In the other opening of the grenade was inserted a blank cartridge, and a firing pin was held at the apex by a split ring. On impact, the pin was driven into the base of the cartridge, the discharge of which was communicated directly to the grenade charge. The latter was at first 150 grams of black powder; weight of grenade 1 kgm., range 140 meters. Later it was altered to contain 50 grams of high explosive; range 350 meters, weight 425 grams. It is in use in the Russian Army.

The English and French armies use a grenade of the Hale type. There is a cylindrical steel body provided with grooves, which prevent too minute fragmentation. It generally breaks into about 100 pieces. The ignition compound is contained in a cylinder inside the case, around which is packed the bursting charge of trinitrotoluol. A firing pin is held in place in the base of the cylinder by two bolts, which in turn are held by two rings. One ring is released at the moment of firing; this releases the other, which in turn releases the bolts. The pin is still separated from the ignition charge by a spiral spring. When the grenade strikes the target the pin is driven thru the spring into the primer. The grenade has a rod which fits in the rifle barrel, and which remains with the grenade during its flight, guiding it. Accidental detonation is impossible, on account of the safety devices, and the grenade cannot explode within about 15 meters of the rifle from which fired. Impact on water, mire, loose earth, or snow is sufficient to detonate after firing. The grenade weighs 650 grams. The maximum range is 460 meters.

A shrapnel grenade has been constructed on the Hale model. The shell is of brass instead of steel. Between the explosive and the shell are 252 shrapnel balls, total weight thereof 175 grams. Naturally this grenade does not function as a true shrapnel, since it is detonated on impact.

GUERRILLA WARFARE

[Notes on Jungle Warfare. By Capt. E. M. Holday, 41st Dogras. *Marine Corps Gazette,* Dec, '17. 5000 words.]

In jungle warfare proper, the nature of the terrain imposes march formations on a narrow front of long columns in file or single file, along a single line of advance. The country varies only in respect to whether its surface is flat or hilly. The power of maneuver is extremely limited. Airplanes are useless.

Troops employed in jungle warfare will almost invariably be acting on the offensive, while the jungle tribes opposed to them will be on the defensive, which includes the power to counterattack. The objective will be the penetration of the enemy's country, driving him back wherever met with, until his resistance is broken and he surrenders.

It is seldom possible to inflict a crushing defeat, as the enemy will not resist when threatened on a flank. Attention must therefore be paid to the destruction of all objects which enable him to prolong the struggle, the burning of villages, seizure of grain and live stock, and the destruction of building materials near his villages.

The jungle dweller has many advantages; he knows the ground, he can see where the ordinary man is blind, he is swift and noiseless in the jungle, he is on the defensive and can invariably secure a good line of retreat, and he is practically invisible.

His method of attack is firing at close quarters from the jungle and bolting; charging with swords and spears, and sometimes attacking camps at night, tho as a rule he prefers to work by day. For defense, he builds excellent stockades, protected on the flank by smaller subsidiary stockades and in front by concealed rifle pits.

The size of columns depends on the number and character of the enemy as well as the work required to be performed. The larger the column, the longer the line on the march and the greater the difficulty of protection on the move and of finding a suitable camping ground when at rest. In former operations columns have varied from 200 to a brigade.

Only very small portions of the column are visible to one another and therefore a great deal depends on the section commander, who must not hesitate to act on his own initiative to repel local attacks. Section commanders should act energetically in mutual support, not forgetting to send word to the column commander to inform him fully as to what is happening.

Before entering a village send flank sections round outside the village on both flanks and extend your point, place guns and Lewis guns where they can give covering fire. The point is advanced by short rushes letting flankers keep ahead. Extend sections in rear as they come up, reinforcing flank sections till the advance guard arrives at the far end of the village and you have surrounded it. Detail parties to search each house, and to look for hidden grain.

Enter a camping ground as if it were a village, so that all-round protection is secured at once. Halt main body and transport till ground is cleared, detail clearing party to get to work at once and post pickets while ground is being cleared. As soon as completed. march main body and transports to their allotted places and start entrenching. During the daytime station pickets over water, and far enough out to permit grazing or cutting fodder. At night have all pickets inside the perimeter if possible. If detached pickets are necessary they must be strong enough to be self-supporting, and must take up their positions in time to allow for entrenching before dark.

GUNNERY

See

FIELD ARTILLERY—FIRE

GUNS

See also

ARTILLERY

GUNSHOT WOUNDS

[Gunshot Fractures of the Long Bones of the Extremities. By Lieut. H. M. Frost, M.R.C. *Military Surgeon,* Mar, '18. 7000 words. Illustrations.]

(The writer has been Chief Assistant Surgeon of the American Women's War Hospital at Paignton, England. He presents in this article some of the results of his experience in the treatment of fractures of the arm, forearm, thigh and leg. The subjects of joint complications and nerve injuries are not touched upon in the paper, which is confined to a consideration of compound diaphysial fractures. The matter is treated in a comprehensive, technical manner. The article is not suitable for condensation but should be consulted in the original by medical officers, who will find it of interest and value. It is to be continued in later numbers of the periodical.)

[Gunshot Fractures of the Long Bones of the Extremities. By Lieut. H. M. Frost, M.R.C. *Military Surgeon,* May, '18. 6500 words. Illustrations.]

(This is a continuation of the author's valuable contribution on the subject indicated by the title, based upon his experience as Chief Assistant Surgeon of the Red Cross Military Hospital No. 1 at Paignton, England. The present installment treats especially of bone infection and its treatment. Twenty-nine photographs of cases found in practice are used to illustrate the text. The article is to be continued.)

[Gunshot Fractures of the Long Bones of the Extremities. By Lieut. H. M. Frost, M.R.C. *Military Surgeon,* June, '18. 7600 words. Illustrations.]

(The concluding installment of Lieut. Frost's extensive and illuminative treatise on this subject. The articles are so complete that they should be consulted in the original. A condensation would fail to give any adequate understanding of the manner of presentation.)

GYMNASTICS, Military

[Uncle Sam, Builder of Men. *National Service,* Apr, '18. 3200 words. Illustrated.]

(A brief description of the physical training in the camps of the National Army. The idea of the article is thus summarized in the foreword: "They go into the mill of the training camps narrow chested and flabby of muscle, and come out healthy, happy, alert and straining to take their place in the fighting ranks.")

[The Arrangement of and Exercises on Obstacle Courses. *Kungl. Krigsvetenskaps-Akademiens Tidskrift,* Jan, '18. 1500 words.]

In connection with the article, "The Training of Infantry for Trench Warfare," some outlines are here given for the arrangement of and exercises on obstacle courses.

Regarding the arrangement of such courses, the character of the field ought to be kept in mind in choosing the obstacles, and the courses also ought to have value in a gymnastic-athletic respect. In our "manual of gymnastics for the army and navy," the obstacles are chosen from these points of view. Some of the obstacles do not strictly belong to those which are encountered in trench warfare. New kinds of obstacles ought to be chosen, however, not such as are positively dangerous or would tear the equipment too badly. The obstacles ought to be taken from both sides.

The obstacles are given in the following order:

1. Rows of irregularly laid plane stones (tussocks), about seven stones in every eight meters.
2. Wall, 3 m. high, with storm ladders.
3. Ditches 0.75 m. deep and 7.5 m. long for creeping.
4. Rampart 0.75 m. high for free jump.
5. Poles 8 m. long for balancing over a moat of about 2 meters' depth.
6. Moat 1 m. deep for long jumps, the nearest edge steep, the other one gently sloping in consideration of the different lengths of the jumps. The moat may be taken from the opposite direction thru side jumps of the steep side.
7. Parapet 1.5 m. high for mounting and running down. The parapet may be taken from the other direction running and then a depth jump.
8. Ditches 1.2 m. deep and 8 m. long for stealing forward.
9. Parapet 1.5 m. high, with a firing embankment behind and finally a moat 1.2 m. deep.

Among new obstacles the following seem to be convenient:

Obstacles for tripping, low stretched wire (not barbed), hidden if possible, about 10 m. wide.

Palisade about 2.5 m. high (eventually each second lance 2 and the others 2.5 m.

Wire netting (not barbed) lying flat, 5 m. wide.

Rampart of earth, about 3 m. high and very steep (2:1).

Obstacle of felled trees.

Obstacle of poles, distributed in a space of 10 m., eventually with pits between them, but without pointed bottom stakes.

Fence (the Swedish fences are mostly built of loose round stones) 1 to 1.2 m. high and sufficiently strong to resist a rush.

Walls made of boards, at least 2.6 m. high.

The manual emphasizes the variation of the exercises in the order of the obstacles. The exertion of the arms (mounting walls and parapets) is not immediately repeated. The jumps over stones, high jumps and downward leaps are separated by other obstacles, and squatting methods of moving (creeping, stealing) do not immediately follow each other. The principles of gymnastics are fully observed in this order.

The new obstacles may be put in between those of the manual, but they might also be arranged thus:

1. Objects of tripping.
2. Palisade.
3. An obstacle "Spanish riders" (literal transl. from Swedish) [*Chevaux-de-frise?*—Ed.]

GYMNASTICS, Military—Continued

4. Fence.
5. Wire netting lying flat.
6. Rampart of earth.
7. Obstacle of felled trees.
8. Wall of boards.
9. Obstacle of poles.

The distance between the obstacles ought to allow sufficient space for jumps and for stopping before the tripping obstacles, the fall of boards, etc. A distance of about 10 m. is sufficient except in front of the moat for long jumps, where it ought to be 15 m.

The width of the obstacles (the track) depends upon the space necessary for each man and the number of men who are supposed to pass the track simultaneously. For side jumps, balancing, etc., each man needs a space of about 2 m. In order to pass the wall of boards or a palisade without special means, the troop (with heavy field equipment) must divide into groups of four in order to help each other. Thus at least four men ought to be able to pass the tracks simultaneously, and for this purpose it ought to have a width of 9-10 m., for eight men about 18 m., etc. The track of obstacles ought to be placed in a part of the exercise field where it may be used as a continuation of a practice of combat which might have led the troop or parts of it towards the track. Being able to use it from both directions, it may be used very often.

All these exercises ought to be prepared for by training in a gymnasium.

To complete and to make the program more interesting, exercises in bayonet fighting, hand grenade throwing, and swimming (on the ground) might be undertaken, the material for which ought to be available in the immediate neighborhood of the track. Rushing thru the track ought to be followed by hand grenade throwing and bayonet fighting, at first against dummies, then against an adversary in which latter case guns (with bayonet), masks and gloves ought to be placed at the last obstacle. The exercises ought to follow a well meditated plan and order.

Increase of efficiency ought to be gained by teaching of the technique of conquering the different obstacles, then the taking of the obstacles in series, but without demand of speed, bye and bye increasing the number of obstacles and finally demanding the greatest possible agility and rapidity. No attention ought to be paid to a uniform and simultaneous execution.

Increase of efficiency may also be gained by degrees by using heavier or increased equipment.

The obstacles ought to offer different degrees of difficulties, permitting an increase from a relatively easy to the most difficult way of conquering them.

[The Bearing of the Individual Soldier. *Kungl. Krigsvetenskaps-Akademiens Tidskrift,* Jan, '18. 800 words.]

(This article emphasizes the importance of a correct bearing of the individual soldier, and gives detailed information on the correction of its faults by the aid of Swedish gymnastics.)

HANGARS

—Location and Arrangement of

[Underground Hangars. *Sphere,* Mar 9, '18. 200 words. One illustration.]

The British aviators have bombed the German aerodromes in Belgium so persistently that they have forced the Germans to seek protection by constructing underground hangars. The hangars are covered over with concrete supplemented by a layer of sand bags and a coating of earth. An inclined concrete runway is provided leading up level with the ground from which the machines can take the air. This runway is camouflaged with paint. A great deal of labor is required in the construction of the hangars.

HANSA-BRANDENBURG AIRPLANE,

[The Hansa-Brandenburg Tractor. *Aerial Age Weekly,* Oct 29, '17. 900 words. Illustrated.]

Of the aircraft captured by the Italians, the Austrian Hansa-Brandenburg machine is regarded as one of the most interesting and important, and a number of details of authentic measurements of this machine have recently been obtained.

Span, upper plane	12,240 mm.
Span, lower plane	11,720 mm.
Chord, both planes	1,713 mm.
Area, upper plane	2,770 sq. meters
Area, lower plane	1,790 sq. meters
Gap between planes	1,713 mm.
Overall height	3,142 mm.
Overall length	8,370 mm.
Motor, Warskalowski	200 h.p.

Ailerons are attached to subsidiary steel tube spars to the rear of the main wing beams. Attachment is made with a fitting of sheet metal and soft wood blocks, with fiber to take up the wear. Each aileron has five such hinges. Ailerons each 2850 mm. long. Wing beams are cut in two vertically, hollowed for lightness and mortised together with hardwood strips. Entering edge is curved to a diameter of 40 mm. Front spar centered 100 mm. from leading edge. Wing spars 800 mm. apart. The interplane struts are of 32 mm. diameter steel tube with their ends terminating in eyes for attachment to the strut sockets. Hollow wood fairing strips are bound to the rear of the strut tubing, giving it a streamline form, and bringing its width to 126 mm.

Overall width of fuselage, 1020 mm. From the forward engine plate to the rudder, the fuselage is 7180 mm. long. A formed cap fits over the forward engine plate, and the propeller shaft goes thru it. The longerons are solid, 30 by 45 mm. at the front, the lower pair tapering to 19 mm. square and the upper pair 17 mm. square. The pilot's seat is set in a recess formed at the top of the main fuel tank. Overall dimensions of the tank—top 500 by 820 mm.; bottom 700 by 820 mm.; height 650 mm. A fixed machine gun is provided for the pilot, located on the upper plane.

The horizontal stabilizer is in one piece, resting on the upper longerons. From tip to tip the elevator flaps

measure 3500 mm. Edges are formed of 15 mm. tube, and outer tip is curved to a 120 mm. radius. The vertical fin is triangular, 700 mm. high and 1300 mm. wide. The axle is of steel tube, 54 mm. outside diameter, 46 mm. inside, located at a point 1680 mm. from the front of propeller hub. Landing wheels are 770 mm. in diameter by 100 mm. wide, and centered 2070 mm. apart. Two sections of streamline fairing are bound to the axle, with a claw brake between them. The motor is a Warskalowski water-cooled 6-cylinder vertical motor, rated at 200 h.p. The propeller is 2800 mm. in diameter, centered 1802 mm. above the ground line when its axle is horizontal. The radiator is mounted above the motor just forward of the upper plane, supported from the cabane by a pair of brackets.

HAXEF

—Marshes of

[The Marshes of the Haxef. By Manuel Escolano. *Mem. de Ingenieros*, Mar, '18. 1500 words. 1 figure.]

The valley of the Haxef, very marshy, has been until recently the most formidable obstacle which our troops encountered in field operations in that entire region. Due to its location it is essential that it be passable for our troops at any time that they may have to move in the vicinity.

The valley is about three kilometers in width, sensibly flat, and is traversed by the Haxef River and two tributaries. After rains the valley is frequently flooded, often as many as two or three times in the same year. The rivers soon fall, but the slack water is slow in returning to the river beds or in seeping away thru the soil, so that the entire valley is one great lake and marsh during most of the year. Consequently the crossing is difficult and dangerous, pack mules and their loads being lost fairly frequently.

In the summer of 1916 military operations made it necessary to construct a crossing which could be used by motor trucks as well as animal transportation. This task was given to a detail of engineer troops, who had the help of infantry details in completing the task within the time limit allowed them.

The location of the bridges for the three river crossings was determined by the height of the banks, the nature of the ground along the banks, and the condition of the river channel itself. The location of the road could only be determined after a detailed reconnaissance. The road itself was constructed by the labor of infantry details, the engineer troops being employed on the construction of the bridges.

HEART DISEASE

[Report on Neuro-circulatory Asthenia and Its Management. By Thomas Lewis, M.D. *Military Surgeon*, Apr, '18. 7800 words.]

(This article is a brief description of the experience and results obtained in the British special military hospital for heart cases, especially with regard to Da Costa's "irritable heart of soldiers," now renamed "Neuro-circulatory Asthenia." The report must prove of interest and value to all medical officers, who should consult the original. There is appended a bibliography of twenty-six references. The article is self-summarized as follows:

1. An affection known in civilian practice, but greatly exaggerated and very common among soldiers under the present war conditions, has been described and a new name for it, Neuro-Circulatory Asthenia, is suggested.

2. The method of dealing with this large group of cases by the British army has been described, and its value in sorting, in therapy, in reducing hospital staff by half, and in establishing an equitable basis for pensioning has been sufficiently proven to recommend that the United States Government adopt a similar plan should the same disorder become prevalent among the American forces.

3. All medical officers of the American forces should learn to recognize the clinical picture of this syndrome, and a certain selected number should have the opportunity of studying such cases and of learning by actual experience to employ a system of graduated exercises as a therapeutic measure and as an aid to categorization.

4. To limit the occurrence of this disorder in a prophylactic way it is suggested that—

(a) Measures be taken for the *early* recognition of cases of N. C. A., i.e., at the time men are called to service and at the training camps.

(b) Men who are seen to flag or show signs of breathlessness by their drill instructors should be reported to the medical officer and thoroly overhauled from the point of view of this syndrome at an early date.

(c) The period of convalescence after infectious diseases be made sufficiently long, and, after complete recovery, the soldiers be gradually hardened before returning to full duty.

5. It is strongly recommended, above all, not to transport soldiers suffering from this disorder overseas for active service, as it is now known that their period of service on full duty is short.)

HELMETS

—Armored

[Protection of the Soldier—The Helmet. By Charles Nordmann. *Revue des Deux Mondes*, Mar, '18. 4000 words.]

(A semi-historical discussion of the development of defensive equipment for the soldier. The author discusses the conditions of defensive personal armament before August, 1914, noting that up to that time, offensive weapons had been steadily developed in effectiveness while defensive weapons had suffered a retrogression.

The era beginning August, 1914, is indicated as marking the start of a development in all defensive equipment. The Adrian anti-shrapnel cap was the first modern head protection. Its development into the present trench steel helmet is taken up. The article includes a detailed discussion of the various types now in use, their actual effectiveness against all sorts of blows, and the proportion of head wounds avoided by their use.)

HELMETS—Continued

[Helmets. Notes. *Army & Navy Gazette,* Aug 31, '18. 300 words.]

The French helmet, a model for the different "styles" in use by the belligerents was invented by Gen. Adrian. He first invented a *culot* of steel, ½ mm. in thickness to be inserted into the head-dress. From this make-shift the present helmet was developed and adopted in July, 1915. It is 7/10 mm. thick, and has reduced head wounds in the French Army exactly one-half. The convexity of the helmet lessens the chance of shock to the wearer and also of it being blown off the head of the wearer by a shell-burst and thus becoming a projectile. Its ventilation at the top equalizes the transmission of shock all over the head. Side ventilation concentrates it in one part.

HIPPOLOGY

See
HORSES

HOOKWORM

[Ankylostoma Duodenale, A Symposium. *Military Surgeon,* Mar, '18. 5000 words.]

(The symposium consists of two articles on the subject of hookworm in the new armies of the United States. A brief discussion of the kinds, occurrence, and life history of the hookworm is followed by a description of the methods employed and the results obtained in surveys for hookworm infection in various commands.)

HORSES

See also
CAVALRY
MOTOR TRANSPORT
VETERINARY SERVICE
WATER SUPPLY—FOR HORSES

—Breeding of

[Horse-Breeding. By Breeder. *Memorial de Caballería,* Oct, '17. 1800 words.]

(Continuation.)

In this number the writer treats of the marked degeneration noticed during recent years in the English thorobred horse. He attributes the degeneration to the fact that selection for reproductors, both in Spain and in England, has been made by taking the qualities of stallions in order of desirability as follows:

Performance, pedigree, conformation and health.

This method of selection has resulted in the perpetuation of defects to such an extent that not one horse that could be characterized as extraordinary has been imported up to the present date. "Good" horses are but rarely found, the majority of the horses imported being "mediocre." The conclusion of the writer is, that in selecting stallions for reproductors *conformation* and *health* should be considered before *performance* and *pedigree.*

—For Cavalry—Choice of Breeds

[The Remount in Aragón. By Baños. *Memorial de Caballería,* Jan, '18. 770 words.]

Aragón is particularly suitable for the breeding of draft horses, inasmuch as it is an agricultural province. Stockmen in such a country cannot breed entirely for the army, to the neglect of the farmhorse. From the nature of the soil, the Aragonese are forced to use a heavy type to cultivate to the depth of 30 centimeters.

Draft horses may be divided into coach, light, and heavy. Disregarding the coach, the distinction between the other two is that the heavy works at a walk and the light at a trot, *i. e.,* siege and field artillery. To vary from a standard type is to invite ruin, and with this in mind, breeders of Aragón use the Percheron and Bolognese at stud. Aragón has become the Perche of Spain.

—For Cavalry—Qualifications of

[What Horse for the Cavalry? By Various Officers. *Jour. U. S. Cavalry Assn.,* Apr, '18. 4500 words]

Brig.-Gen. W. H. Hay, N.A., favors a three-quarter bred of the Virginia hunter type, or a three-quarter standard bred animal between 15- and 15-3 hands.

Brig.-Gen. J. G. Harbord, N.A., favors a horse under 15-2 hands, conformation proportioned to height. He prefers a three-quarter bred Arab to a three-quarter bred animal.

Brig.-Gen. M. H. Barnum, N.A., believes the horses in the cavalry should range between 15-1 and 15.3—between quarter and half-bred animals.

Col. F. LeJ. Parker, N.A., inclines to a horse about 15-1 or 15-2, rather under than over half-bred for the troop horse—three-quarters for the officer's mount.

Col. E. L. Phillips prefers an animal from 15 hands to 15 hands 2 inches, strongly built.

Major Ben Lear, Jr., Gen. Staff, inclines to a cow horse 14-3 to 15-1 full barreled, closely coupled, and weighing 1000 to 1075 pounds.

Lt.-Col. E. A. Sirmyer places first the mount between 15 hands and 15-2, three-quarter bred preferred to the half bred.

Lt.-Col. George Williams, N.A., likes a horse between 15-2 and 16 hands, thorobred first.

Col. S. B. Arnold prefers a mount 15 to 15-2, but the conformation of the animal should be the first thing to consider. The cold blooded or quarter bred horse is better.

Col. G. C. Barnhardt, N.A., desires a strain of thorobred from one-half to full.

Col. G. W. Moses, N.A., thinks the Morgan horse comes nearest to fulfilling his ideal of a cavalry mount.

Maj. G. P. Tyner believes the product of a thorobred sire and standard bred dam the best mount for a trooper, height 15-1 to 16 hands.

Col. S. McP. Rutherford, N.A., is in favor of a horse not over 15-2, preferably cold-blooded, and exceptions to be made of especially good animals over that height.

All the above officers want an animal of good conformation, strongly constructed.

—**Forage for**

See

FORAGE

—**Horseshoeing**

[Horseshoeing. By F. Garcia Marco. *Revista del Ejército y Marina,* Dec, '17. 1000 words. 1 plate.]

(A historical article dealing with the development of horseshoes and the art of horseshoeing from the time of Alexander the Great.)

HOSPITALS

See also

AUSTRIA—ARMY—SANITARY SERVICE
CANADA—SANITARY SERVICE
INVALIDS
SANITARY SERVICE
UNITED STATES—ARMY—SANITARY SERVICE

[Evacuation Hospital at Jassy, Rumania. By Lt.-Col. Arturo Sola. *La Guerra y su Preparación,* Apr, '18. 3000 words. Cuts, photos.]

The plans for this hospital were taken from the French Medical Dept. plans and were executed under the direction of Lt. Cosminsky of the Rumanian Engineer Corps.

The hospital consists of four wards each 11 x 40 meters. Each ward is divided into two sections by a longitudinal wall. These wards are one story high. There are also four wards 11 x 20 meters by two stories high. These wards are placed end to end in pairs of single and double storied buildings, with a roadway between 6 m. wide. The upper stories of the 11 x 20 wards project over this roadway.

A space is provided in the center of this group of buildings for storehouse and kitchens under one roof; and for the administrative building under a second roof. On one flank of the ward group is located a third accessory building which houses the hydrotherapic services and equipment.

The one story wards have an 80 bed capacity, the double story a 66 bed capacity, giving a total capacity of 584 bed patients, which in an emergency could be increased to 800.

The construction of these buildings is much like that of our own cantonment buildings. It is all pine lumber, ceiled and double walled.

The construction was carried on almost entirely by foreign labor at an average cost of 300 lies (Rumanian francs) per bed.

—**Hospital Ships and Boats**

[French Military Hospital Ships. *Modern Hospital,* Nov, '17. 360 words.]

The French hospital ships were a great help to the army at the beginning of the war, when the battles of the Yser were being fought, and the wounded were many. The ship would lie in a northern channel port, taking the wounded as they were brought from the front by train or ambulance. When full the ship would put to sea and in a few hours discharge her patients at a western port. The rolling of the ship was far better borne than the constant jolting of a train, particularly in fracture cases. Later on, as additional ships came into service, they were less hurried, and could lie at bases, doing duty as comfortable base hospitals, in France, at Mudros, and elsewhere. The question of personnel is important. Ten orderlies should be furnished for every one hundred patients. In the hospital barges used by the Austrians on the Danube and the Save there were 12 orderlies for every 100 "lying" cases and 4 for every 100 "sitters."

—**In Civil War (U. S.)**

[A Few Civil War Hospitals. By Maj. Casey Wood, M.R.C. *Military Surgeon,* May, '18. 4000 words. Illustrated.]

(This is an interesting article describing briefly some of the more important hospitals constructed and used during the Civil War. It is illustrated by drawings and by photographs of models in the Army Medical Museum. A noticeable feature is the close constructional and architectural resemblance between the later Civil War hospitals and those recently built in the cantonments thruout the country. The article gives the general instructions issued by Secretary Stanton on July 20, 1864, to officers charged with the construction of general hospitals. The specifications contained in these instructions provide for buildings remarkably like those now in use.)

The first large, wooden, one-story structure provided with the now familiar ridge ventilation was erected at Petersburg, Va., early in 1862. At first, fault was found with this new method of ventilation because there was no protection provided against rain, snowstorms or high wind. The buildings were otherwise satisfactory, and as soon as transoms were provided for use in inclement weather the new type of hospital was universally conceded to be a great success. So true was this that little change has been found desirable since then.

On Dec 17, 1864, there were 192 general and special hospitals in active use by the United States. Their total capacity was 118,057 beds. The largest of these hospitals were: Harewood, 2000 beds, and Lincoln, 2575 beds, at Washington, D. C.; Mower, 3100 beds, and Satterlee, 3519 beds, at Philadelphia; Jefferson, Ind., 2399 beds; Madison, Ind., 2430 beds; U. S. General Hospital near Fort Monroe, 3497 beds. There were also 27 others with capacities of 1000 to 1800 beds.

—**Railroad**

See

SANITARY SERVICE—TRANSPORTATION OF SICK AND WOUNDED—HOSPITAL TRAINS

HOWITZERS

See also

ARTILLERY
FIELD ARTILLERY
FIELD ARTILLERY—MATERIEL

HYDROAIRPLANES

See

AERONAUTICS

AERONAUTICS—SEAPLANES

[Flying Boat and Hydroaeroplane for Sea Flying. By Lt. G. Adamoli, R.I.F.C. *Flying,* June, '18. 2660 words. Illustrated.]

At the beginning of the war, there were two schools and two different methods which the builders of seaplanes followed. The conception of the French school was to build hydroairplanes similar to the land airplane, and the American conception (or rather the Curtiss conception) to develop the flying boat. The hydroairplane, conceived by the French, was easier to build, so constructors of land machines tried to transform their machines into hydroairplanes by applying floats in place of wheels. As a flying machine the hydroairplane with floats is reasonably perfect and is excellent for training. When the machine must alight on the water as in this case, it no more possesses the stable balance which it possesses when floating on calm waters. When landing in such conditions, the seaplane can seldom be saved. This occurrence will exist until floats are made large enough so they will continue to rest upon at least the tops of two waves—in other words, until the hydroairplane has reached a power of several thousand horsepower. Flying boats have been developed at the same time as the seaplane. In these machines, as the motor must be placed between the wings, over the boat, so that the propeller can turn above it, they generally have the line of lift and the line of thrust separated by the centers of gravity and of resistance; which fact does not exist in the seaplanes with floats or in the land machines, as in these types all the centers are grouped as much as possible.

At the same time that these boats were built, pilots had to be trained for them. In this training, two different methods were used. (1) The method of training the pilot directly on the seaplane. (2) The method of giving the pupil a preliminary instruction on the land machine and afterwards continuing and completing the training on the seaplane. By the first method it often happened that the pupil had to be dropped from the school after a certain time because he was not fit for hydro-flying. This is not the case with the second method.

The method of starting depends entirely on whether the machine must start with a head wind, a tail wind, or a side wind. (1) In the first case the pilot starts the motor gradually, keeping the rudder in a neutral position and the elevator in the maximum position for climbing. By controlling the elevators, the propeller's blast is used in keeping the stern part of the boat down. In this way the machine cannot upturn and gradually acquires such speed that the nose of the boat comes out of the water up to the step. At this moment the pilot gradually puts the elevator in position for descending. This maneuver makes the nose of the boat tend to immerse. The machine is supported by the wings and on the step and skims the water in this position until the velocity is sufficient to life the machine entirely out of the water. (2) When the starting must be made with a side wind, the operations are as in the first case, but the pilot must lightly incline the machine so as to lower the wing on the side from which the wind is blowing.

Landing is the most difficult maneuver for the hydro pilot, this being due to the different conditions of the water on which the machine must alight, conditions which vary according to the light and the wind. With the water slightly disturbed, landing conditions are best, gauging the height being easy and the landing therefore less difficult, either with or without speed. To land with speed is easier and can be done in the common way. Landing without speed requires from a pilot a greater sensibility of the minimum velocity of the machine, and also an excellent perception of height. The rougher the water the better its surface can be seen and the greater is the necessity to land without speed so as not to jump over the waves. Landing with water smooth as a mirror is the most difficult task a hydro pilot may face. The water reflects the sky and it is difficult to see the surface and to gauge the approximate height. Hydro schools generally keep a motor boat always moving about.

In Europe, hydro schools are located with special care so as to give the maximum efficiency by using water surfaces without any obstacles. During the time the machines are in flight at least one motor boat is always moving about to give assistance to the pupils in case of difficulty and thereby avoiding the possibility of drowning. Generally near all the harbors of importance there are squadron centers for fighting hydroairplanes of the two types: those for pursuing enemy hydroairplanes and those for submarine chasing. The flying boats for submarine chasing are used only to carry bombs. Every section has a machine flying all day long, and they fly as far as 60 miles out to sea. The task of these machines is to discover submarines and to attack them either by dropping bombs on them or by attacking with machine guns. No doubt the day is near when all coast patrol, mail service along the coast and between coast and islands, will be undertaken by flying boats.

HYGIENE

See also

SANITARY SERVICE—CAMP HYGIENE

SANITARY SERVICE (Article: "Health for the Soldier and Sailor")

ILLUMINATION

See also

SEARCHLIGHTS

[Battlefield Illumination. By Capt. R. C. Kuldell. C.E. *Professional Memoirs,* Nov-Dec, '17. 2400 words. 1 plate.]

Battlefield illumination has now become a responsibility of all line officers, as well as of certain officers of staff departments. Illumination by means of searchlights is a function of the engineers; that by trench lights, and by flares, rockets, illuminating grenades, star shells, etc., pertains to all branches of the service.

(The writer here gives all the tactical uses to which searchlights may be put.)

On the defensive, in order to obtain sufficient illumination in each zone, it is calculated that there should be one light for each 1000 yards of front. The lights should be arranged in groups of three, a 24-inch light on each side of a 36-inch one at intervals of about 1000 yards. With two 36-inch and four 24-inch lights assigned to each division, it will be possible to cover 4000 yards with this arrangement and spacing, keeping one of the 24-inch projectors in reserve. The six lights for a division are attached to the divisional engineer train, and are under the command of the train commander. In prepared positions the searchlights will be located by the division engineer.

For any sector of defense there must be telephone communication between the group commander and the commander of the sector of defense, as well as between the group commander and his observers and operators. The 36-inch lights are used for searching; the 24-inch for illuminating the target after it has been picked up. The lights work intermittently, the beam being exposed not longer than twenty seconds at a time, to prevent ranging upon it. When used in connection with artillery, as soon as the target is located the lights remain masked except just after the salvo is fired, when they are unmasked for the purpose of observing the result. The most favorable position for observing is about 50 yards to one side of the searchlight and a short distance in rear.

On the offensive, searchlights have fewer uses, as the attacker endeavors rather to take advantage of the darkness to capture the defender's position which he has reconnoitered during the daytime. In case of a check, however, the searchlights come into play.

The care and operation of searchlights is a highly technical duty, and requires long, careful training. In addition to thoro familiarity with the upkeep and use of the different elements of the unit, experience is necessary in the selection of sites, as well as in the operation of the lights over varied ground and under different atmospheric conditions. This part of the training completed, experience must then be gained in the use of the searchlights in conjunction with the infantry and artillery.

Battlefield Illumination with Trench Lights.

There has recently been supplied a type of incandescent trench lights for use on poles, with storage batteries for their operation. The lights, batteries and charging outfits will be maintained with the engineer trains. In action they will be turned over to the infantry during the afternoon or evening with batteries charged. The battery will operate the light for five hours continuous running. As the lights will be used only intermittently in trench work, it is probable that one charging of the batteries will last for two nights. At present 24 trench lights are assigned to each division. The light gives sufficient illumination for 200 yards in its front. The beam is a cone with an angle of dispersion of 30 degrees.

Ordinarily the lights will be located in front of the fire trench. Their location is a matter of the utmost importance. Improperly located they serve to define exactly the trace and flanks of the line. If allowed to shine too long they furnish excellent aiming points for the enemy's fire. On the other hand, if carefully located and operated, the lights can often be used to deceive the enemy as to the exact location and extent of the position.

Rockets, Star Shells, Illuminating Grenades and Bombs.

All these illuminants are propelled from the rifle or mortar high into the air, where they ignite and burn with a brilliant light for ten to thirty seconds.

The advantages of this method of illumination are:

(a) The light comes from high in the air, hence no long shadows. It illuminates the foreground to a distance of 500 yards.

(b) With no wind or a favorable wind the light can be placed over the desired object without revealing the location of the operator.

(c) It requires no special technical training and no expensive equipment.

(d) The cost is low.

The disadvantages are:

(a) With a reverse wind the light may be carried back over the projector's trench and serve the enemy.

(b) For this reason the time of burning must be limited to ten seconds and more rockets used.

(c) The range as a projectile is limited to 200 yards in a favorable wind.

Each company should have selected men trained in the use of the rifle illuminating grenade. The remainder of the company must be trained to pick up quickly and deliver fire upon the target while it is illuminated by the light of the grenade.

Flares.

A flare is usually a paper cylinder containing a combustible such as nitrate of potash, sulphur and orpiment, or magnesium ribbon, which burns for about a minute with a brilliant flame. The ordinary flare is about 14 inches long and 1 inch in diameter, wrapped in oiled paper. For illumination in defensive work they are most often used in a pit, and so arranged that a touch on a trip wire will elevate the flare and ignite it. The flare may also be ignited by a wire operated from the trench. In the offense the chief use of the flare is for signalling to airplane observers, to mark the limit of the advance, or for similar purposes. When thus used the flares should be placed in the bottom of shell holes or other depressions.

—For Night Attacks

See also

INFANTRY—NIGHT OPERATIONS

INDIA

—Army—Organization

["Improvement and Further Development of the Indian Defence Force." I. D. F. Prize Essay Competition. By Capt. D. S. Mackay, East Coast Rifles, I.D.F. *Jour. United Service Inst. of India,* Apr, '18. 4000 words.]

The Indian Defense Force comprises the (a) Light

INDIA—Continued

Horse Corps, rank and file Europeans, officered by Europeans; the (b) Infantry Corps, rank and file Anglo-Indians, with some pure Asiatics and a sprinkling of Europeans, officered by Europeans; the (c) Artillery and Specialist Companies, like (b) but with men of somewhat better type and physique; and (d) the Railway Corps, whose special conditions place them outside any ordinary scheme. This discussion may properly be confined to classes (a) and (b). Even in these classes there are differences which affect the application of any contemplated scheme.

The Indian Defense Force Act aims to cause every person qualified under the Regulations to undergo training. The best of this training will be received on actual service, but men must be trained to some extent before they are fit even for garrison service in time of war.

The first step in the improvement and further development of the I. D. F. is to make the officers believe in themselves and that they are doing something useful. They should be admitted to general and special classes of instruction. The important thing is to teach the officer what soldiering means, to give him a touch of discipline, confidence in himself, a taste for command, a knowledge of military customs, a demonstration of military life, and a breath of military atmosphere. Meanwhile musketry and drill can be learned.

These classes should not consist of I. D. F. officers alone, but should be mixed in with regular officers whenever possible. The work should be hard and the day full.

The officers should command, and not the sergeant-instructors as is too commonly the case. Officers and non-commissioed officers who have qualified should be utilized. Specialists should be given opportunity to teach other officers who need instruction, and to teach the men at all times.

The best training is that given in association with regular and territorial companies, but this is not always possible. The worst defect of the I. D. F. officer is his word of command, and his best quality is his keenness. One great difficulty in training is in diversity of age and condition of men, and different time liability for training. This can be partially obviated by the adoption of a suitable time schedule for training.

Bands should be sent about to visit pricipal detachments once or twice a year for the purpose of inspiring enthusiasm and interest.

The introduction of a larger professional element in the I. D. F. would be of doubtful value, as there is already too great a tendency to rely on the Staff and Instructors.

Under present conditions, good soldiers can be selected to command rather than men of civil influence. Examinations and a system of confidential reports could be used to maintain efficiency.

A section or larger force of regulars or territorials should be sent to every I. D. F. camp for professional example and precept. The social side of camps must give way to soldiering. Rewards should be made to depend upon something more than mere length of service.

Planter Corps are generally run on the equality and fraternity basis. In past days good will alone held these corps together, but this condition no longer obtains, and less bonhomie will result in greater military efficiency. Discipline is a vital question, and now the regulations give sufficient power to enforce it. An officer who cannot now maintain discipline should not hold a commission.

—History

See also

SIND, CONQUEST OF

INFANTRY

—Arms

See also

BAYONET

EUROPEAN WAR—FORCES ENGAGED—INDIA

Austria

[Notes on Austrian Smallarms. By Gaetano Forni, Lt.-Col. of Artillery. *Rivista di Artiglieria e Genio,* Oct-Nov, '17. 10,000 words.]

Historical sketch of the Austrian army rifles and pistols, from the adoption of the breech loader to the present; detailed and technical descriptions of recent types, with numerous illustrations and tables of numerical data.

[Small Arms of the Austrian Army. By Gaetano Forni, Lt. Col. of Artillery. *Rivista di Artiglieria e Genio,* Dec, '17. 7000 words. 4 plates.]

(This instalment of the long continued paper deals with machine guns, and gives a detailed and technical description of the various types in use, with numerous illustrations.)

[Current Topics—Small Arms Research by the R. F. C. Anon. *Arms and Explosives,* Sept 2, '18. 380 words.]

Up to this time, because of superior equipment and because of routine training favoring it, most research work has been done by the inspection department. Officers of this department are often not in close touch with the demands of actual service. This must necessarily be true but, because of it, defects are found in installed equipment which a greater familiarity with the conditions of service would have eliminated. The air service has brought its own excellent methods of research to bear on this problem with very good results.

Decentralization of experimental work may be wrong in theory, but it has the advantage of bringing different minds to view a single problem, each from its own particular angle.

—Arms—Bayonet

See

BAYONET

[Purchase of 300,000 Rolled Bayonets Is Recommended. *Official Bulletin,* Oct 29, '18. Quoted.]

The War Department authorizes the following from the Department of Ordnance:

So successful and satisfactory have been the preliminary tests with a rolled bayonet, recently submitted, that the Production Division of the Ordnance

Department has recommended the letting of a contract for 300,000 of the new type. The rolled bayonet saves approximately 70 operations in manufacture and, of course, by just this much would, when quantity production is reached, speed up the output. Five hundred and fifty of them were recently tested at the Bridgeport plant of the Remington Co., the test proving highly satisfactory.

Bayonets as at present made require a series of operations, machining, hardening, and tempering of drop-forge steel, which to a very great extent are done away with by the rolling process. It is estiated that in addition to the saving in time there would be a material reduction in labor requirements, as with equal factory equipment only about one-third the labor would be required to turn out the same number of finished bayonets.

—Arms—Grenades

See

GRENADES

—Arms—Rifle

See also

ENFIELD RIFLE

[The Queen of Weapons. By "Oudeis." *Army & Navy Gazette,* Aug 24 '16. 1200 words.]

(An article calling attention to the fact that the rifle of the infantry soldier still holds its plae as "Queen of weapons." However, "Oudeis" reminds his reader of the fact that it is a scientific weapon and care should be taken to make the soldier fully cognizant of the proper way to obtain the maximum benefit of his arm.)

[The Science of the Rifle. Part of Chapter I—The Action. By F. H. Kelly, M.B. *Arms and Explosives,* Sept 2, '18. 5000 words. 2 diagrams.]

The action of a military rifle consists of the body, the bolt, the magazine, and the trigger parts. The function of the action is to load and fire the cartridge, resist the pressure of explosive gases, and eject the cartridge case.

Early fire arms were muzzle-loading, tho the invention of breech-loading is itself very old. Cannon were used in the 14th century in which the breech was closed by a block which was wedged in place before firing. Before 1747, small rifled cannon were used which were load thru a hole in the side, the hole being closed by a screw.

The development of rifling necessarily had to follow that of a satisfactory form of breech mechanism. The solid residue of early powders was so great that bullets, for practical use in muzzle-loading arms, were, of necessity, of smaller diameter than that of the rifle bore. Otherwise they could not be used in a fouled bore. Under such conditions, it made little difference whether the bore was rifled or not.

Successive methods of igniting the charge have been: by match to the touch-hole; the match-lock; the wheel-lock, the principle of which is revived in some modern cigar lighters; the flint-lock, at the beginning of the 17th century; and the percussion system.

The percussion system, first applied to firearms by the Reverend Mr. Forsyth in 1807, made breech-loading a practical possibility. Its successful application is known to us in the form of the percussion cap.

The prevention of the escape of gases to the rear, the main defect in this system, remained an unsolved problem until the middle of the last century; when the self-contained cartridge with brass case was invented. This solution of the problem of obturation drove the muzzle-loading type from the field of practical firearms.

There have been innumerable devices for closing the breech, all involving the principle of a movable block behind the barrel. For military rifles where loading from a magazine is essential, some form of the "bolt" action has been found most satisfactory. Numerous falling-block actions, in combination with tubular magazines, are found: all with the disadvantage that the point of one cartridge rests on the cap of the next.

In all bolt actions, the bolt moves back and forth along the prolongation of the bore. The bolt is held firmly in place in the firing position by the engagement of lugs on the bolt behind holding surfaces on the body of the action. The position and bearing of these lugs are of the greatest importance. Unevenness of load on the lugs and inequality of strength of the two sides of the action cause unusual vibration and inaccurate shooting. In a proper design the lugs should be near the front end of the bolt.

Most bolts are closed by a push forward and a quarter turn to the right. The lug recesses are cut slightly aslant so that the quarter turn moves the bolt forward into its seat with a screw motion. In straight-pull actions, the bolt handle is attached to a hollow sleeve on the interior surfaces of which are helical grooves engaging with helical lands on the outer surface of the bolt proper. This type is operated by a straight pull back and forward with no turn. Theoretically faster, it has the practical defect of giving a weaker primary extraction (the first loosening of the cartridge case after firing).

Bolts are either solid head (one piece) or with a loose head. The main advantage of the loose-head bolt consists in the fact that when the lugs become worn, the excessive play of the bolt can be remedied by fitting a longer head; whereas, in the solid-head type, the entire bolt must be replaced. The solid head permits the placing of the lugs nearer the front end of the bolt, giving a stronger action.

Extractors are of various types; the generally adopted design, for the one-piece bolt, being some form of the Mauser extractor.

The position of the bolt has an important influence on the rapidity of fire. The Lee-Enfield, by an accident of design, is the fastest rifle existing. This is true because the bolt handle is so close to the trigger, when the bolt is closed, that the rifle can be fired by the second finger without withdrawing the hand from the bolt handle. The arrangement of the 1914 Enfield is not so fortunate in this regard.

The first military breech-loading rifle, also the first bolt-action rifle, was the Prussian needle-gun, invented in 1838, adopted in 1848. In the cartridge for this arm, the cap was inside the charge, the latter being perforated by the needle which exploded the cap. The

INFANTRY—Continued

rifle also had unsatisfactory obturation. In 1867 the muzzle-loading Enfield was converted to a breech-loader by the application of the Snider action.

The firing arrangements of the bolt action include the firing pin, which terminates in the striker and is actuated by a powerful helical spring; the anvil, contained in the cartridge; the bent, the groove on the under side of the firing pin, in which the sear engages; the sear; and the trigger.

The elements of the mechanical train from the trigger to the sear, for the depression of the latter, show considerable variation. The pressure on the trigger, necessary to release the bolt, varies from 5 to 7 pounds. This is used partly to overcome the resistance of the trigger spring and partly to overcome the friction between the sear and the bent. The grip of the surfaces while at rest is called "stiction" and is, or should be, greater than the friction of the surfaces when in relative motion. The trigger spring has little effect on the trigger pull, its function being to hold the sear more firmly in its seat in the firing pin. The angle of the engaging surfaces is such that a certain amount of locking effect is obtained.

No attempt should be made to improve the trigger pull by tampering with the trigger spring. The only available method is to alter the shape and angle of the bent. Since the force required to disengage the sear from the bent is already quite small, an adjustment of this sort must be made with the greatest care or danger of accidental discharge is introduced.

Theoretically the proper way to improve a trigger pull is by a change in the lengths of the lever arms. Safety from accidental discharge is unaffected; the trigger pull is a little longer but not too much so. Another method, used in the short Lee-Enfield, is to have two bearing surfaces on the upper arm of the trigger; the one closer to the trigger pivot being the first to bear on the lower sear arm. Midway of the pull, the second, further from the pivot, comes into play, relieving the first.

A valuable innovation appears in the Ross rifle, in which the sear is pivoted on a roller bearing which is pressed against a groove in the under side of the bolt. This prevents any change of the relative position of sear and bent which might result from excessive looseness of the bolt.

The usual method of cocking the striker is by means of cam action, operated by the quarter turn which initiates the opening of the bolt. In the Lee-Enfield and some others, however, the bent is caught by the sear as the bolt advances. This action is a violent one and may result in derangement of the trigger pull and in accidental discharge due to the shock incidental to a rapid manipulation of the bolt. On the other hand, the operation of the bolt is much easier in the latter arrangement.

—Arms—Rifle—Automatic

See also

MACHINE GUN

[The American Automatic Rifle. *Army & Navy Gazette*, Mar 9, '18. 320 words.]

By the latest information from Washington we learn that the American Ordnance Department has made a final and exhaustive series of tests of the new Browning automatic rifle which the soldiers of the United States National Army will shortly be using in Europe. It is a curious reflection that one of the least military of the nations engaging in this war should be the first to design and arm its troops with an automatic rifle, the manufacture of which has already begun and of which many thousands will now be issuable every week. Here in Europe we have been discussing the use of an automatic rifle since the days prior to the outbreak of the war with the Dutch Republics; we have often debated the question whether such a rifle should merely be self-loading or whether it should be both self-loading and self-firing; and the reasons given for the failure to adopt any of the many weapons of this kind in the market have been reduced to two—the belief that no automatic rifle yet invented was quite suited for military purposes, and that the fire-discipline required of the men thus armed must be of an immensely improved character. There is, of course, a limit to the rapidity of fire required, since if the first bullet is ill-directed the remainder of the stream will certainly be even more so; and it would seem that what we want in an automatic rifle is that it shall be a self-loader rather than both self-loading and self-firing. It is evident that the Americans do not hold the opinion that the improved degree of fire-discipline required for the automatic rifle cannot be demanded of the short service, temporary soldier, and also that they are prepared to cope with the enormously-augmented cartridge supply which the use of the Browning rifle will call for.

—Arms—Rifles—Sights

See also

PERISCOPES—FOR TRENCH FIRING

[The Open Sight and the Human Eye. By T. R. Paganelli, M.D. *National Service*, Apr, '18. 1500 words. Illustrations.]

The old notch rear sight and peg front sight break all the laws of optics and renders accurate aiming well nigh impossible. This sight starts out with the premise that a man can focus his eye on three different objects at three different distances at one and the same time, a feat that is humanly impossible. The fact that riflemen have done so well in the past with these sights is a remarkable demonstration of what grit and will power can do.

Some thirty-odd years ago the United States shocked the military world by adopting the Buffington peep sight for the 45-70 Springfield rifle. This sight, in a modified form, was retained in the Krag and the new Springfield. It lost much of its usefulness by being placed so far from the eye that its orthoptic qualities were seriously impaired. In the new Lee rifle, the Model 1917, the peep sight has been placed at last where it belongs—near the eye. But why not carry the aperture principle to its logical extent? The old peg front sight should also be discarded and replaced by the Maxim-Vickers aperture. This double aperture combination is like looking at the objective thru a tube. It concentrates the powers of vision on the target where

they should be. The blurring of the sights thru not being in focus is then a positive advantage, since the alignment of the barrel must be that much more nearly perfect in order that the target may be seen.

—Arms—Sword

See also
FENCING

—Attack

See also
ATTACK

—Fire

[Target Practice With and Without Alcohol. *Schweiz. Zeitschrift f. Art. u. Genie,* Sept, '17. 85 words.]

Tests made in Bavaria have conclusively demonstrated the deleterious effects of alcohol on rifle shooting. Thirty minutes after the firers had drunk one liter of beer their scores diminished twelve per cent.

[Theory of Fire. Study by The School of Musketry, Ft. Sill, Okla. *Infantry Jour.*, Aug, '18. 15,500 words. 27 figures, 6 tables.]

The introduction of this study states that the object of all musketry training is to increase the fire efficiency of troops, which is dependent upon two general classes of factors—moral and physical. A part of the soldier's training in musketry is designed to reduce the moral factor to its minimum. Nervousness arises in part from unfamiliarity; maneuvers, combat problems and field firings enable a soldier to do the routine things in battle that he practised in peace. Fright is an emotion common to all at times, but in the soldier it generally results from lack of food, rest and confidence rather than from the presence of actual danger.

Confidence of the soldier in himself and in his rifle is built up by individual practice in shooting. Confidence of the soldier in his leaders and companions is built up by practice in combined shooting. These two confidences breed battle confidence which is essential to efficiency.

Efficient fire direction comes from a thoro knowledge of the theory of fire. The way to study the theory of fire is to study each factor in order to learn its proper relative value in the efficiency of the fire.

This study is then divided into seven lessons: (1) The Trajectory and Sheaf or Cone, (2) The Shot Group, (3) Distribution in Depth and Width, (4) Danger Space, (5) Effect of Slopes and Sites, (6) The Influence of an Error in the Estimation of the Range, (7) The Influence of the Point of Aim.

—Fire—Instruction and Training

[Fire Exercises on the Map. By José Romero Oreggo, Maj. of Infantry. *Mem. de Infanteria,* Aug, '17. 6000 words. 10 diagrams.]

(A series of solutions based on graphic constructions and solutions of triangles, as follows:

Assuming an origin of fire and a fixed position for the enemy:

1. To select a point along any line joining the two positions for delivering the most effective fire against the enemy.
2. To determine angles of slopes and reverse slopes between the positions.
3. Range to be employed.
4. Beaten and grazed zones.
5. Zones defiladed from view from both positions.
6. Zones defiladed from fire.
7. Points from which grazing fire may be delivered against reverse slopes occupied by the enemy.
8. Depth of the shot group on horizontal ground, and on ground above or below the line of sight.)

[Some Notes on Musketry Training and Field Exercises. By Lieut.-Col. Harry Lee, U.S.M.C. *Marine Corps Gazette,* Dec, '17. 5000 words.]

The object of these notes is to bring about a uniform training in the companies of the battalion in order that when the battalion is assembled for any exercises, tests or maneuvers, the action may be machine-like, and the individuals be perfectly at home, whether the units be intermingled or not. To this end, the exercises laid down must be taken up and gone thru in a thoro manner, supplemented by a short talk by the company officers, who should explain in detail the object sought in each particular exercise.

Next, the tests should be taken up and in them the rules should be rigidly applied. These tests are simply the carrying out of the exercises under certain rules, restrictions, and conditions. All should be carried out to the letter in order to measure the probable efficiency of each organization practicing.

The faithful effort of every officer is necessary to the success of the battalion as a tactical unit. It requires teamwork, and teamwork requires that each member have a task, which he must thoroly understand. He must know what to do, and when and how to do it quickly and accurately. The proper direction of the advance must be continually watched by the leaders of the units; all should endeavor to advance directly on the point at which they fire. The company commander and chiefs of sections make the signals, each to the unit leader next below, and observe the proper execution of the movements, the effect of the fire, and the keeping of direction. The sergeants should constantly watch the next higher commander for signals; squad leaders should so place themselves as to watch their chief of section. All others should look to their target, in order that, on arrival at the position, their bayonets may pierce their targets.

The instruction should be thoro and at the same time interesting. This cannot be done if any mystery is to cloak a portion of it, hence the necessity for full explanation in two-syllable words, avoiding technical terms.

All the responsibility for most of the casualties in units is chargeable to the officers, if they have not, when there was time, taken advantage of it to increase their own knowledge and to teach it all to those under their command, for use in the field.

—Fire—Instruction and Training—Target Practice

[Has Instruction of the Infantry in Sharpshooting Lost Its Importance? *Kungl. Krigevetenskaps-Akademiens Tidskrift,* Feb, '18. 700 words.]

INFANTRY—Continued

Trench warfare is liable to give the impression of the unimportance of the instruction in sharpshooting, on account of the great variety of weapons which are now used to support the attacks of the infantry, whose firing takes places almost exclusively within the shortest range. If future wars are to be begun, conducted, and ended as trench warfare, the sharpshooting schools may limit themselves to the shortest ranges. This reasoning is, however, incorrect, and implies the depreciation of the demands of open warfare.

Shooting at very long ranges will hardly take place in our exercises. Our instructions recommend opening of fire only within effective range (200-600 m.). Shooting at short range and against very small targets ought to be given more importance.

In connection with the above, the information given by English prisoners taken in the latest battles of Flanders ought to be remembered: "Our casualties in the surprisingly rapid German counter attacks were very large. Some companies were completely wiped out. The German infantry was shooting excellently. The German sharpshooters were specially praised for their great number of hits in the head. In one company 60 per cent were killed by hits in the head."

[Training and Instructions for Small Arms Firing Before Going on the Rifle Range. By First Lieut. E. E. Brong, M.C.R. *Marine Corps Gazette*, June, '18. 1500 words.]

The object of the system of rifle training and instruction is to make of individuals, qualified marksmen, who in battle will make hits instead of misses; to make of organizations, pliable, manageable machines, capable of delivering in battle a volume of effective fire.

The former is accomplished by individual training and instruction whereby the skill of the soldier as a rifleman is so developed as to be up to the capabilities of his rifle. This can be accomplished by erecting an A, B and D target and assembling the class. Lectures should then be given on the following topics: How to set sights; how to sight or aim; how to hold the rifle in all positions and the general principles; the care and cleaning of the rifle; dimension of targets; padding; the sling; blackening the sights; the prone, sitting and kneeling positions; examine each clip; canting the rifle; breathing while aiming; focusing eyesight on target; holding under and on the bullseye; trigger squeeze; jerking the trigger; snapping before firing; calling shots; zero of the rifle; quarter point windage rule; the square or elevation rule; keeping the score book; range duties; spotters; markers; range rules; coaching.

The instruction in sighting and aiming must be thoro. The steps of instructions are as follows: Explain aiming by placing a rifle on a rest so the rifle cannot move when sighted on a regulation target at 200 and 300 yards. The same method at 500 and 600 yards; then have another tripod with sand bag rest at the same ranges, require each man to place and aim the rifle himself, then inspect it.

To teach trigger squeeze: place the rifle on a rest so it cannot move after having sighted properly at a B target at 500 yards, then require each man to practice the trigger squeeze. Each man after squeezing the trigger will note that he has the same aim as he had before squeezing the trigger and as it should be at the instant of the discharge of the rifle.

When men fail to qualify on the range it is as a rule due to the poor shooting at rapid fire, at 200, 300 and 500 yards, due to the fact that the men do not get enough training in snapping on the D target. This can be overcome by having a wooden target painted regulation size and erected on the parade ground at a convenient place. The companies at daily drill should be required to go thru the rapid fire exercise in the same manner as on the range. This should be continued thruout the year whenever troops are at drill under arms and not only for two or three weeks before going on the range. With this continuous instruction the men will develop self-confidence and know that they have plenty of time. It should be impressed on the company commander's mind that the daily drill is an absolute necessity, more so than his daily inspection.

[Coleman Hold and Trigger Squeeze Device. By Lieut.-Col. W. P. Coleman, 341st Inf. *Infantry Jour.*, Aug, '18. 700 words. 2 figures.]

This device is designed to show the soldier's ability to properly hold his rifle on the target while squeezing the trigger. A rigid frame, one foot long, on an elevating standard, carries on one end a bull's-eye target and on the other end a needle. The rifle, with the sling adjusted is held in the prone position, the point of the needle slightly within the muzzle, and the sights aligned with the line of sight touching the lower edge of the bull's-eye. An electric circuit, carrying two dry cells, a bell and a switch is attached at one end to the needle, at the other end to the barrel of the rifle. When the piece is held steadily, the needle not touching the barrel, the switch is closed and the soldier is told to fire. The ringing of the bell indicates a derangement of the aim when the trigger is squeezed.

[Results of Sharpshooting with Rifles in the Swedish Army During 1916-17. Kungl. Krigsvetenskaps-Akademiens Tidskrift, Jan, '18. 1000 words. 3 tables of results.]

(The sharpshooting has only taken place during the time of training of the soldier, and not during maneuvers on account of lack of ammunition. Both the cavalry and the infantry received such instruction. The results were very good.)

—Instruction and Training

See also

INFANTRY—FIRE—INSTRUCTION AND TRAINING
INFANTRY—TACTICS—INSTRUCTION AND TRAINING
SAPPING AND MINING (Articles: "Sapping Operations; Especially for Infantry" and "Mining Operations; Especially for Infantry")

[Maneuvers of French Divisions in Instruction Camps. By Maj. E. Requin, French General Staff. *Infantry Jour.*, Jan, '18. 1300 words.]

The development of instruction during warfare is one of the characteristics of the present war, and is also one of the consequences of the constant evolution

of combat methods. It is as necessary that, in the complicated machine of modern combat, all great units should form a homogeneous and working whole as to have a perfectly disciplined and trained personnel.

Before the beginning of the war the combat unit was the army corps of two divisions, but now the division is the true combat unit, the army corps now being a unit of command, consisting of from three to five divisions.

Many camps for the purpose of resuming and perfecting the instruction of divisions have been formed in each army zone. The divisions pass thru these camps of instruction before going into a big offensive movement, and practically every detail of the attack is so rehearsed that the men are able to act almost automatically in battle. The success of this method of instruction has been noted on the Somme, at Verdun, and in all the recent operations.

The combined instruction of the large units is given under the personal supervision of the generals of divisions, according to the directions and under the control of the superior units of command. The aim of sojourns in these camps of instruction is to encourage the men to go forward, to give cohesion to the different subordinate units, to give all leaders the opportunity of commanding in their place of battle, to teach all to combine their fire and their movements in accordance with the latest methods, and finally to teach the different arms to co-ordinate their actions. The whole idea is to prepare for a combined offensive.

The time in the camps is divided between the preparation of the subordinate units of the division, and the carrying out of a combined offensive by the whole division.

The combined maneuver of the division is preceded by a maneuver of the commissioned and non-commissioned personnel. This preparatory maneuver covers the attack from the installation of the division in front of an enemy first position thru the attack of the second position, with a study of concrete cases of tactical and strategical exploitation.

[Memorandum on Infantry Instruction. *Infantry Jour.* Jan, '18. 3800 words]

(Extracts from a report made by the department instructor, Southeastern Department, August, 1917, for the information of division, brigade and regimental commanders.)

Attention is invited to: (a) Lack of accurate knowledge on the part of officers and non-commissioned officers of the drill regulations and manual of physical training; (b) Lack of efficient supervision on the part of superior officers, and (c) Lack of realization of the importance and size of the task which confronts officers who will have to train the army to be sent to Europe.

Most of the comments deal with the garrison training of infantry troops—the training on which rests real discipline. In calling attention to defects noted in close-order drill there is no intention to detract from the importance of training in practical field work.

The very foundation of efficiency in an army is military discipline. This is built up and maintained principally by means of close-order drills. A perfunctory performance of close-order drills and physical exercises fails to accomplish the purpose for which they are instituted and is an actual waste of time.

The defects mentioned in this memorandum apply to infantry troops of the Regular Army and of the National Guard, but to a greater degree in the case of the latter. Officers and non-commissioned officers show a lack of familiarity with the provisions of Infantry Drill Regulations; their knowledge is general, not accurate and detailed. The set-up of the men is faulty; drills are not executed with snap and precision; guides do not display careful instruction in their duties; distances and intervals are not accurately observed; and the dressing is not accurate in drills and ceremonies.

Schedules of instruction show ample time for training of this character. The defect lies in a want of accurate knowledge on the part of company officers and non-commissioned officers, and a lack of proper supervision by battalion and higher commanders. The failure to acquire accurate knowledge of the drill regulations on the part of instructors is probably due in a great measure to their inability to visualize that which they try to teach the men. Frequent tests will be necessary in carrying out a proper supervision of drills in order to determine the state of progress and instruction.

The value of a parade depends upon the accuracy of its execution in all details. This cannot be judged from the position of the reviewing officer, but the instructor or inspector must view it from a flank and pass along the rear of the lines. In battalion drill the battalion should be formed with the field music playing. (Other points to be noted in battalion drill are mentioned, as well as the principal defects in company drill.)

Bayonet exercise is not satisfactory. Expert instruction should be given officers and non-commissioned officers who in turn could spread this instruction in their own regiments.

(Many other tests, which can be conducted in a half-day and which will give the inspector a clear idea of the efficiency of the regiment being tested, are outlined. These tests include visual signaling, road sketching, writing field messages, bayonet combat, and first aid work.)

Accurate knowledge must be acquired; general information will not suffice. Programs and schedules of work to be followed are essential to progressive instruction. However, the best schedule will accomplish little unless followed up day by day with constant and intelligent supervision.

[Intensive Training of the Infantry Soldier, the Infantry N. C. O., the Infantry Squad. By Major Elvid Hunt, General Staff, U.S.A. *Infantry Jour.*, Aug, '18. 10,000 words. 1 diagram.]

(The article presents a study of the possible application of the principles of "Scientific Management" to individual soldier training. The arrangement of the text is such that it may be used as a manual or as a

INFANTRY—Continued

program of intensive instruction. The article is a reprint from "The Manual of Intensive Training" published in 1916 by Major Hunt. Its suggested standards of training, physique and morale for the soldier and the management of instruction are rather closely followed in the War Department's "Provisional Infantry Training Manual, 1918, Training Circular No. 9.")

Great Britain

[Tests of Military Efficiency in England. By Lt.-Col. Fernando Rich. *La Guerra y Su Preparación,* Feb, '18. 900 words. Figures.]

These tests are in the form of a series of exercises given on the drill grounds at Aldershot.

Construction of Entanglements

This exercise is carried out by 20 soldiers under an officer, the object being to construct an entanglement 20 meters long under the supposition that it is the dead of night and in the presence of the enemy. The former effect is secured by covering the men's eyes with heavy blue veils. They must remain absolutely silent. The uniform is field uniform without pack, gas mask in the alert position. Men wear heavy but flexible leather gloves.

At a given signal the section moves out. Four armed men are detached and put out as listening posts, the rest of the detachment follows with the matériel. Upon reaching the designated spot they form line, arms extended sideward until points of fingers touch, and the posts are located. The posts are iron rods 1.25 meters long with a corkscrew point. After the double line of posts is located, eight men place the stakes in position so as to stretch the wires tight, and the other eight men commence to stretch the wire on the posts. Four strands are stretched along each line of posts, then joined to the stakes in the same line. Stakes have also been placed on the side of the wire facing the enemy and strands are run from the top of the posts to these stakes. The next step is to stretch four more longitudinal wires on the inclined cross wires from posts to stakes, thus further increasing the difficulty of a passage from the enemy's side of the wire. When the exercise is half completed a bomb is exploded which indicates a gas attack, and everyone who does not get his mask in position within eight seconds is declared a casualty.

This exercise may be carried out in 13 to 18 minutes.

Simulated Artillery Fire

In this contest, each group consists of a complete section under an officer with six men per piece, four telephone operators, two men in the observation points, and two with the battery. All men wear gas masks in the alert position.

Section commander gives the firing date as soon as the pieces are in battery, and time is taken from the instant the Command "Commence Firing" is given until the sound of the last round of three per gun is heard.

The orders to commence fire, etc., are given from observation points, and during the firing a gas attack alarm is given. Everyone must have his mask on within eight seconds after that alarm is heard.

Competing sections are graded on a basis of 100 points.

One point is deducted for every second over 60 that it takes the gun to get into battery; five and two points respectively for each officer and soldier who are declared casualties because of slow or improper adjustment of gas masks; ten points for every minute that a gun is out of action on account of lack of crew; five points for every error in deflection and elevation, for every improperly set fuse, or any other similar error; and ten points for showing deficient or only fair instruction.

—Maneuvers

[Combined Exercises with Ball Ammunition. By Gen. Maximo Pascual de Quinto. *Memorial de Artillería,* Jan, '18. 12,000 words. Maps, sketches.]

(A detailed description and critique of the combined exercises held by the "Infante" Infantry regiments and the Fifth, Seventh and Thirteenth Mounted Artillery regiments, near Tudela on Sept 16, 1917.

The author was at that time commanding the artillery of the Fifth Region and as such prepared and directed these maneuvers.

There is nothing particularly new in the maneuvers themselves. The tactical supposition was that the enemy, to the strength of a division, occupied a strongly intrenched line around Tudela and intended to attack and take Tudela, breaking thru a strongly intrenched defensive line held by the above mentioned forces.

The author presents his article in the form of a summary of the orders issued—first to him, concentrating the troops for the exercise, then by him, ordering the various dispositions taken by the different organizations.

In this manner the reader knows the general and special situations, the tactical plan and how it is to be worked out.

The remainder of the article is a chronological summary of orders issued by the various regimental commanders, and by the independent unit commanders.)

—Night Operations

[Problems in Battlefield Illumination. By Capt. W. S. Drysdale, Inf. *Professional Memoirs,* Nov-Dec., '17. 500 words.]

The problem here described was tested at night with one company, aided by illuminating bombs furnished by the Engineer Train. Indirect fire was used.

The problem was one in which the hostile firing line (represented by 64 kneeling figures) was almost entirely hidden from view in underbrush and consequently furnished a very unsatisfactory target. It was 350 yards distant across a valley. An auxiliary target (a small bush) midway between the firing point and the targets was used. A sight setting was given that brought the sheaf of fire into the target.

The auxiliary target being halfway between the target and the firing line, the dispersion at the target was equal to the front of the company firing. Altho the target was practically invisible, 70 per cent of the fig-

ures were hit, the company firing five rounds per man, clip fire.

It is thought that this method would be suitable in a well prepared defensive position. The use of an auxiliary target which is unmistakable and distinct will result in more hits than firing at the target itself, when that target is indistinct as would frequently be the case in combat firing, particularly at night.

—Organizatiton

[Note. *Army & Navy Jour.*, Apr 20, '18. 215 words.]

In view of the fact that some army officers believe that our infantry regiments of 3604 men are too large to be capably or effectively handled it is interesting to note that, according to Lloyd George in his "man-power" bill speech on Apr 10, the Germans had reduced the numerical strength of their units before beginning the present offensive. The British Premier said on this point: "The Germans had organized their troops so as to produce a larger number of divisions out of the slightly smaller number of infantry. They had fewer battalions in a division and fewer men in a battalion. That is entirely a question of organization, and it yet remains to be seen that their organization is better than ours." There may be another explanation of this which is a development of the singular idea possessing Germany that she can frighten people with symbols of force such as, in this case, numbers. According to their characteristic reasoning seventy-five divisions would sound more powerful than fifty altho the German command itself would know there were no more men in the larger number of divisions. What they count on is the enemy not finding out the reorganization until the statement of large numbers has had its proper psychological effect. That it never does have the effect the German mind calculates on never alters its psychology in the least.

Germany

[War on Land. *Army & Navy Gazette*, Apr 6, '18. 1500 words.]

As to the tactical methods the enemy is using, we have nothing much as yet to go upon, but we find some interesting hints on the subject from a French source. Some weeks ago we touched upon a tactical development on the part of the Germans, which appeared first in their attack on the Dvina last autumn. The method was one of surprise; the divisions that were to operate were kept a long distance off, there was only a short bombardment by way of preparation, the assaulting columns made sudden forced marches to the chosen sector, moving by night and hiding from the airmen by day. Now, General von Hutier it was who used this method so successfully in Courland, and it is this same chief who has been commanding the right wing of the Crown Prince of Prussia's group, that is, the left wing of the present German offensive. We have reason to believe that von Hutier has, during the winter, been training his troops to this *tactique du genre Riga,* as another French critic calls it; but he must have found Briton and French a different quality of foe.

As for the composition of German regimental units as we find them now, we should be chary of ascribing serious man-power weakness to the enemy on the ground of their reducing the number of regiments in a division and the number of bayonets in a battalion, for there has proceeded, *pari passu* with such diminutions, a considerable addition to the foot soldiers whose weapon is not the bayonet, and who are not in the ranks of the companies. Battalions have the four companies they have always had, and these seem now to be content with 150 men each as their establishment. This would make a notably small battalion, but the attached men, using other weapons than the bayonet, put a different complexion on the matter. Each company has three sections. In 1917 an attempt was made to have a fourth section, but this appears to have fallen thru, and this may show lack of men. Detachments of light machine guns are provided to the tune of two weapons per section, which at one stroke adds 120 or more men to the battalion strength. Then come, per company, two grenade-throwing machines, which add from 50 to 100 men to the battalion. Beyond these they have four mine throwers, light ones carried by the men, throwing a 10 pound shell to 1500 yards, and the battalion has also 12 heavy machine guns. These two bodies plainly augment substantially the real strength of the battalion.

When you come to those special units called *storm battalions,* you find four companies of infantry, a company of 16 light mine throwers, a company of 30 heavy machine guns, a section of 10 flame throwers, and finally a battery of 4 guns of the "77" brand, specially mounted for taking to pieces, like mountain artillery. Thus there does not look to be much real weakness in the German units. Outside of these battalion effectives, the division has 36 picked machine gun crews and a large company of 300 mine-throwing men, who work four heavy and eight medium weapons.

The use of the troops in attack has become pretty clear since Mar 21. Here we have no deliberate objective, with a carefully nursed reserve for each sector. Everything is moving forward together—front line, supports, reserve. The moment the first line slows down, the succeeding division closes in to it, goes thru it if necessary. It is a tactics that looks to very rapid results, and that can only have abiding success thru an early break of cohesion in the enemy. It did succeed, but at frightful cost, in transforming our salient between Arras and St. Quentin into a German salient of Montdidier, but it produced no fraction of breakage. German confusion and intermingling in the area Scarpe-Montdidier-Noyon must be prodigious, on account of this very method in which they have used their divisions, and it is quite enough to account for the marked slackening in their advance.

—Protection for

See also
BULLET-PROOF SHIELDS
HELMETS—ARMORED

—Special Duties

[Duties of Engineer and Infantry Officers with Regard to Working Parties. British Army, '18. *Infantry Jour.*, July, '18. 1500 words.]

Infantry working parties which work in co-operation

INFANTRY—Continued

with the Royal Engineers are of two kinds: (1) parties detailed to perform a particular piece of work in connection with which R. E. technical assistance is provided, (2) parties attached to R. E. units to furnish unskilled labor.

When parties are detailed as in (1) it is important that the infantry officer should know that he is responsible for the amount of work done by his men and see that their safety is provided for while at work, paying particular attention to the necessary precautions against gas. The R. E. officer is responsible for the setting out and the explanation of all details of the work to the infantry. He will act in an advisory capacity and is responsible that the work is done at the right place, but not for the quantity and quality of the work. He should so distribute his N. C. O.'s. and sappers so as to show the infantry N. C. O's how the work should be done. He is also responsible for providing the stores and tools necessary for the work and which cannot be provided by the infantry.

The officer in charge of the working party should be informed of the urgency of the work in order that he may know whether to continue or withdraw in the event of suffering casualties.

In order to get the maximum work done with the minimum number of casualties, the working party should be conducted to the work with the least possible delay and fatigue and the work should be accomplished as quickly as possible.

To achieve this it is necessary to make the proper preliminary reconnaissance which will include (1) the route to work and time of march, (2) meeting place for guides, (3) where to draw tools and stores, (4) the task and subdivision of working parties, (5) enemy observation, *i.e.*, limits of movement in daylight. The question as to whether the men will require food while on the work should not be overlooked.

A proper organization of the working party is also necessary. This will include the detail of guides, usually from the R. E., to direct the working parties to the place of work. Every precaution to insure the proper conduct of the working parties to their tasks should be taken. The working parties should be organized into groups of not more than ten men and the work should be allotted by tasks.

To get the best from the men it is necessary to explain to them the object of their work. It is the duty of the infantry officer to maintain the strictest discipline while at work, while the R. E. officer should act as a technical adviser.

—Tactics

See also

ENTRENCHMENTS—TACTICS
MARCHES AND MARCHING

—Tactics—Attack

See also

INFANTRY—TACTICS—COMBAT

[Mutual Support. By Lt.-Col. A. W. A. Pollock. *United Service Mag.*, Feb, '18. 3500 words.]

An incontestably sound principle of war is that an enemy who has been ejected from his position shall promptly and vigorously be followed up, so that he may be prevented from rallying his forces for fresh resistance.

In order, however, to hinder victorious units from dangerously isolating themselves in salients of their own creation, it is customary to divide offensive operations into stages, represented by selected lines indicating the intermediate and ultimate objectives of the whole force engaged. Hard and fast rules forbidding a commander to advance beyond any intermediate objective or encouraging him to press on independently are inappropriate. It is better to prescribe only guiding principles and to permit reasonable latitude in their observance.

It is clearly preferable to capture and make good the whole of an objective, after a protracted struggle, than that portions of it should rapidly be reached by isolated fragments of the force, foredoomed to bloody ejection by counterattack.

The sum of that whole matter presents itself as follows:

1. The commander of every unit, large or small, must always bear in mind the fact that he is as fully concerned with the progress of adjacent units as with that of his own.

2. Ground gained by one unit, in advance of another adjacent to it, must usually provide the former with a point of vantage from which to assail in flank the hostile element particularly obstructing the latter.

3. The commander of a unit which is held up must, as soon as possible, inform his more fortunate neighbors so that they may be enabled the more usefully and speedily to render the requisite assistance.

4. The commander of an advanced unit, when about to give aid must satisfy two principal obligations. He must decide whether to hold his present fire positions or to seize others in advance of them and communicate his intentions to the unit which he is about to assist, and to the units on his opposite flank and rear, so as to insure intelligent co-operation in case their help should be required.

5. An advanced unit whose flank has become exposed, owing to an adjacent unit being held up, cannot more effectually safeguard that flank than by attacking in flank the hostile element that has caused the obstruction.

6. If checks and their causes, their continuance and their overpassing are communicated by platoons to companies, by companies to battalions, and so on upwards, the difficult problem of leading will be materially advanced towards its effective solution.

7. If all units in the first line of an attacking force are careful to regulate the pace of their advance and the nature of their local action in accordance with the situation that arises when units on one flank are held up, the connection from front to rear will not be lost; the flank opposed to the enemy will be composed of units in echelon, and therefore far less vulnerable than if perpendicular to the front of attack.

8. There is as much scope for bold and resourceful initiative while clearing away opposition from the flank of a neighboring unit as while pursuing one's own, and devotion to the former obligation is required

in no less measure than to the latter. Sound tactics demand that, while victorious units on one flank shall be assisted by *pushing,* the unsuccessful unit on the other flank shall at the same time be *pulled.* The hands of neighboring units, on both the right and the left, should always be held with a firm grip.

9. Fire and movement are twin brethren, each of whom is absolutely dependent on the other. Assaults are not to be won by bayonets and forlorn hopes, without an adequate fire on the defenses.

[Organization and Duties for Trench Fighting. By Capts. O. N. Solbert, C. of E., U.S.A., and George Bertrand, French Army. *Professional Memoirs,* May-June, '18. 8500 words. 6 plates.]

(One of a series of lectures on "Tactics and Duties for Trench Fighting" now published in book form by G. P. Putnam's Sons. The present installment, Chapter VI, deals with the "Attack of a Position.")

The attack of a position comprises three phases: the preparation of the attack; the assault against the first hostile line; and the exploitation of the success by fighting in the interior of the position. The importance, aspect and order of these phases are not the same as in open warfare. In trench warfare the preparation of the attack is of such preponderant importance that upon the manner of its execution depends the whole success of the operation. The assault, which in open warfare is the final phase, is but the first move of the fight proper in trench fighting.

1. *Preparation of the Attack*

The tactical unit for an attack is the division. The tactical unit for an assault, within the division, is the battalion. The length of the front of attack assigned to the battalion varies with the tactical situation. According to the length of his front of attack, the battalion commander will place two or three companies in the assaulting column, and the remainder in support.

To avoid as much as possible the enemy's barrage and machine gun fire, the distance over which the troops make their assault must not be too great. For this reason parallels of departure, or jumping off trenches, will often need to be constructed in front of the first line for the assembly of the assaulting troops. The trace of the parallels of departure must be parallel to the first line of the enemy, not to your own, so that the assaulting troops will simply have to move straight to the front. In order not to print the attack on the ground, so to speak, these parallels of departure are not constructed unless absolutely necessary, as when the enemy trenches are more than five hundred yards distant. Before launching an attack, certain of the defensive works that play but a passive rôle in the resistance, such as barbed wire entanglements, must be rearranged, modified, or partially eliminated. Other elements, such as boyaux, supply depots, and command posts, that facilitate forward movement of reinforcements, are multiplied.

(The different preparations are treated in detail.)

During the time employed in preparing the ground for the attack, the artillery executes the preliminary bombardment. This comprehends three different kinds of fire; viz, counter-battery fire, fire upon communications, depots, etc., and destructive fire. A certain part of the artillery is detailed to destroy or neutralize the hostile batteries. This result is obtained by methodical fire on precise, designated targets. It is slow work and must be begun long before the attack is started. If the hostile batteries are not destroyed before the attack is launched, they must be neutralized at the proper moment by a concentrated fire of shrapnel and gas shells. The fire on the enemy's communications, besides its destructive effect upon the positions, hinders the arrival of reinforcements, material, ammunition, and food. The destructive fire is that very important fire which is directed upon the enemy's forward positions. The whole position is subjected to a methodical and violent artillery fire for the purpose of destroying obstacles and accessory defenses which may hinder the advance of the assaulting columns, as well as all the elements of the defense, such as strong points, dugouts, machine gun posts, etc.

The observation of the preparatory artillery fire falls upon the artillery's ground observers and the aviation service. But the duty of observing the results of the destructive fire on the enemy's first line is carried out with the help of the infantry observers. Special attention is given to the destruction of the entanglements and the machine gun emplacements. The interested infantry does not content itself with a passive observation, but sends out offensive reconnaissance patrols. Their mission is to actually go into the enemy's front line, to ascertain its condition and to investigate the breaches made in the hostile entanglements. It is both the privilege and the duty of the infantry commanders to state in their daily reports their opinion of the artillery preparation.

2. *The Assault*

The direct object of the assault is to open the way for the attacking troops into the position. It is the beginning of the combat proper. When the breach has been made in the enemy's first line, the assaulting and reinforcing troops must continue the fighting in the interior of the position for its conquest. The attackng troops are disposed in depth in a series of echelons, so that during the advance each echelon is brought into the battle at the proper moment. This rule of formation in depth is followed by every unit of whatever size.

The successive echelons have received the name of "waves." These waves are of different dispositions and of different strengths, varying with the size of the unit considered and with the particular conditons of the attack. As soon as the assaulting echelons are held up by nests of resistance, they are obliged to halt while neighboring echelons on both flanks continue the advance. Reinforcing units will come up from behind to outflank such a nest. As soon as this condition arises within the enemy's position, the disposition of the troops in waves is lost, and the fight is continued in the best formation possible under the circumstances.

(The dispositions for attack in units of different sizes are discussed and illustrated by plates.)

Based upon the divisional order for the attack, the

INFANTRY—Continued

regimental, battalion and company commanders issue their own orders. The order for the attack contains precise details of the following points:

Exact hour of the attack (or signal that will be given).

Details of the successive objectives; different resistances that will probably be encountered.

Time-table of the moving barrage and rate at which it will move.

Prolongation of Telephone lines; particular lines to be extended.

Prolongation of communications; boyaux to be built; units detailed for this purpose.

Supply of ammunition and water in the captured positions; points of distribution.

A few minutes before the hour (H) the men take their places in the jumping off trench with strict orders to remain there. Bayonets are fixed, and useless movements and noises are prohibited. Each man holds himself in readiness for the signal from his immediate chief.

During the time just preceding the hour (H) all the artillery not engaged in counter-battery fire is employed to protect the assault. At precisely the designated moment the first assault wave jumps out of its parallel of departure, the different lines of which it is composed being formed immediately. In a similar manner, as soon as the first wave is launched, the second wave follows it over the top. At first all the lines of the assaulting companies have less distance between them than is called for by the regulations. This is an advantage in avoiding the defensive barrage of the watchful enemy. If the reinforcing line follows closely behind the line of combat, it has a better chance of passing the danger zone before the enemy's barrage is established.

When the first echelon has crossed "No Man's Land," the battalion commander usually launches the supporting companies. The effort is made to choose the exact moment for the departure of the second echelon so as to profit by any lull in the enemy's fire. As soon as all the companies of the assaulting battalion have penetrated the enemy's position, the reserve battalions move forward thru the boyaux to the advanced parallels of departure. Here they await the orders of the colonel to advance for the purpose of joining in the combat for the final conquest of the enemy's defenses. Before giving this order the colonel waits for the first report from his assaulting battalions.

3. *Fighting in the Interior of the Position and Exploitation*

The fundamental principle of the fighting in the interior is that each unit from the division down to the battalion receives a definite objective. Beyond this objective, only patrols and strong reconnaissance parties are sent. Usually the attacking regiments are assigned the mission of capturing the third or covering line of the artillery. The continuation of the struggle beyond this line is called "the tactical exploitation of the success." This operation is carried out by the divisional reserves, held out for this particular purpose. The plan of battle does not include orders for this action.

The advance of the assaulting platoons regulates the advance of all the successive elements. These platoons, after crossing the first enemy line, continue their movement without hesitation. The rate of advance is, of course, variable with the difficulties of the ground and the strength of the hostile resistance. As a part of the assaulting platoon comes the trench-cleaner detachment. The trench cleaners are armed with hand grenades and trench knives. Their function is to enter the hostile trenches taken and to vanquish the last resistance.

As long as the assaulting platoon continues to advance steadily, the reinforcing platoons follow at the regulation distance. If, however, the first elements suffer severe losses or are held up, the reinforcing platoons move up onto the line of combat. Again, if a gap should occur in the combat line, due to losses or extension of the front, the reinforcing platoon fills the gap. The machine guns attached to the assaulting units follow and protect the flanks. They also fire, when halted, on retreating hostile troops and on special points of resistance. Their greatest use, however, is against counter attacks.

The reinforcing companies, with the machine gun reserve and the 37 mm. gun of the assaulting battalion, have in general the same function as the reinforcing platoons of the advanced companies, but on a larger scale.

During the attack the artillery carries out counter-battery fire, protective fire on the flanks of the attack, and barrage fire. The first two kinds of fire are executed by the part of the artillery directly under the command of the chief of artillery of the division. The third is delivered by the support artillery, detailed especially for the use of the different assaulting battalions.

The proper co-ordination of all the developments of the attack lies in a good system of liaison. The means of this liaison are: telephone lines lengthened into the enemy's positions, signal communication, rockets, carrier pigeons, and runners. There is also a special liaison with the air service.

[A Visit to the German Front in Belgium. *Infantry Jour.*, July, '18. 1700 words.]

This article is a translation of extracts from the report of a Spanish Military Mission to the German Army and deals with the assault battalions.

The commission was present at a conference given at the camp of the sturmbattalion (assault battalion) at Audenarde, where there were present about sixty student officers. The lecturer described the means of attack at the disposal of the battalion, and also stated those employed by the enemies of Germany. Since the attack on the first lines was almost always carried out with hand grenades, some officers took the stand that the hand grenade and not the rifle was the principal infantry weapon.

The sturmbattalion is divided into four units—two are companies of infantry, one of machine guns, flame projectors, etc., and the other a battery of artillery. The battalion is made up of picked troops, and its

object is to enter the action at decisive moments of the combat. In the attack of an important and difficult position, the battalion is kept under cover as long as possible and having accomplished its purpose is withdrawn from the first line as soon as is practicable.

Individual instruction in the method of combat of the battalion and the uses of the different kinds of its armament is insisted upon. The commission viewed various platoons in situations corresponding to different phases of the attack and thruout the action the troops used charged service grenades.

The platoons advance, in the advance of platoons entrenched, in groups of eight men divided into two squads. The leading man, who carries sixteen grenades, is the thrower of the squad. He is followed by two carriers with thirty-two grenades each. The fourth man protects the thrower with his rifle, and one of the carriers has a flag which he constantly waves in order that the rest of the platoon may know of the advance of his squad. The second squad follows the first and goes into action when the grenades of the first squad are exhausted. A special grenade with a number of hooks on its body which will catch in the wire netting used to protect a trench, is used to make a breach in the net through which the ordinary grenade may be thrown. In the destruction of wire entanglements, the heads of eight or more grenades are placed on a stick with one grenade left with its handle. This stick is placed in the wire and the grenade with a handle is fired by a pull wire. This fires the group of grenades, as their percussion caps are left in place.

Bomb-throwers of caliber 7.45 cm. were fired with excellent results at 300 meters. These guns resemble rifled mortars with muzzle-loaders mounted on platforms with two wheels, drawn by two men, and with a crew of eight men each. These guns are capable of great rapidity of fire, as the dropping of the projectile into the piece fires it.

The flame projectors are handled by two men, each protected by a mask. The projectors carry petroleum under great pressure and throw a jet of flame about 20 meters.

The artillery of the battalion consists of four short 7.63 cm. guns, and can be employed to put down a barrage 50 to 60 meters in front of their attacking line. The guns are directed by flags and luminous signals and were fired at ranges from 1200 to 1500 meters. Each gun has a crew of eight men, all armed with carbines. The guns are attached to limbers and drawn by two horses. Each limber carriers 18 projectiles.

[Battle of the Somme—Disposition of German Troops for Attack. By B. *Memorial de Artilleria,* May, '18. 500 words.]

Article taken from *La France Militaire* of Apr 3, 1918, which publishes a captured German order. This order covers the German tactical dispositions for attack as follows:

The division was the primary unit of attack. It was divided into two identical parts as follows:

First line.—3 bns. inf., one and one-half cos. M. G. supplementary), one-half company engineer troops, one-half company minenwerfer, one battery 77 mm., two batteries infantry cannon.

In reserve.—One regiment infantry, five captured English tanks, an independent detachment formed by two companies of cyclists and one assault company.

The artillery charged with the duty of supporting this division was made up of both light and heavy batteries. One heavy battery was 210 mm. in caliber.

—Tactics—Combat

[Some Lessons of the War. Army War College. *Jour. Military Service Inst., U. S.,* Sept-Oct, '17. 3800 words.]

At the outbreak of the war the French Army consisted of metropolitan and colonial troops. The latter were spread all over the colonial empire, with the exception of northern Africa, and formed one complete army corps in France.

The metropolitan army consisted of 173 infantry regiments (each of three battalions of four companies) and about thirty other infantry regiments, Zouaves, Tirailleurs, Foreign Legion, etc. There were 91 regiments of cavalry, 62 of field artillery and 9 of engineers.

Officers are obtained from the Polytechnical School at Paris, from St. Cyr, or promoted from the ranks. Non-commissioned officers of two years' seniority in the grade of sergeant are eligible to examination. Senior non-commissioned officers can be promoted to sub-lieutenants without an examination.

The victory of the Marne prevented Germany from crushing France and then turning on Russia. The French Army was kept as a complete fighting unit for France, and for her Allies, who required time to get ready. The whole of France was turned into a gigantic munition factory; the output of ammunition and arms increased from week to week.

The proportion of gunners to infantry in the active army, which was one-tenth at the outbreak of the war, has been brought to one-half (including trench artillery). The infantry was armed with the 8 mm. rifle (model 1886), the characteristic of which was a magazine instead of a clip. The allotment of machine guns was one section of two guns per battalion.

The rifle now uses a clip and there is one company of 8 machine guns per battalion. In addition each company has 8 Fusils Mitrailleurs. Each battalion is provided with a 37 mm. gun for destroying machine gun emplacements, etc. From experiences at Verdun and the Somme French infantry battalions consist now of 3 companies, 1 machine gun company (8 guns), and 1 37 mm. gun. The battalion has thus become a very strong unit, capable of progressing independently, and of breaking most of the resistances it encounters.

The combining of machine guns, automatic rifles, 37 mm. gun and rifle grenades compel the enemy to remain hidden in his trenches while bayonetmen and moppers up and bombers are rushing to hand-to-hand fighting. The weapons with flat trajectories sweep down any objective emerging from the ground while hand and rifle grenades can reach obstacles under cover.

INFANTRY—Continued

Every man has to understand throwing the grenade, and each voltigeur is taught a particular specialty so as to replace, in case of emergency, any specialist who happens to be put out of action. The proportion of voltigeurs to bombers and fusiliers should not be too much reduced.

New weapons are designed to bring about the thinning of the fighting line, and the increasing depth in the formations as well. The intervals between men when deployed should be 4 to 5 paces, and the platoon is formed in successive lines instead of one. The normal front held by a platoon is from 80 to 100 paces. It may either fight in the assaulting line or as a reinforcement. In the first case, its wave will consist of bombers and fusiliers; the second wave, of rifle-grenade men and voltigeurs. As a reinforcement the platoon advances in deployed order or in single file, the specialists marching first. The front of a company in attack varies from 200 to 300 yards while that of a battalion depends upon the objective and the number of companies in the line.

The result may be summed up as follows:

1. Effectives become fewer in numbers.
2. The fighting line is being thinned in the offense, and still more in a defensive situation.
3. The fighting has to be carried out more and more in depth, not only in the regiments, the battalions, and the company, but in the platoon as well.
4. All means of warfare must be decentralized.

These lessons of Verdun and the Somme have been tested in both attacks carried out at Verdun on Oct 25 and Dec 15, which gave back to the French in two days of battle, and with slight losses, most of the ground gained by the Germans in eight months.

The object on Dec 15 was to carry on the right bank of the Meuse all the enemy's observatories on the Cote du Poivre, Hills 342, 278 and Hardaumont, also to conquer the Germans north and northeast of Douaumont.

Four divisions had to carry out the task, with one in reserve. Four more were in the second line. Artillery allotted consisted of 42 mountain guns, 348 field guns, 216 heavy guns and 168 trench mortars.

The first objective was limited by two villages, the road and certain hills and defensive works. The second was limited by certain hills, roads and the village of Bezonvaux.

Each objective was to be reached at once and in one rush, at the pace of 100 meters per 4 minutes (deep mud), artillery creeping barrage keeping ahead, percussion shrapnel, by 70 or 80 meters; high explosive airburst or percussion shells by 150 meters. The attack was launched at 10:40 a. m.; at 3 p. m. the whole position that was being held by 5 German divisions was conquered.

It had been strictly ordered, as it had been on the 24th of October and in every attack on the Somme, that the infantry should start on the whole front of attack at the hour "H." This is of the utmost importance for several reasons:

(a) Because it prevents the enemy from concentrating his fire on particular places.

(b) Because of the artillery-barrage which is put up on the whole enemy line simultaneously.

(c) Because when the whole line advances at the same time, there is no flanking fire possible.

(d) From a psychological point of view, because it prevents any hesitation; if some troops have to wait for starting until the attack on their right or left has gone sufficiently far, they may think that it is not really successful enough to allow them to go over the parapet.

When the whole of the enemy's first line has been entered, then the troops who are ahead wait for those who have been delayed.

The front of attack was 400 meters per battalion, with two companies in first line and one in reserve.

In order to prevent the battalions of the second wave from being held by the enemy's heavy barrage, they had been brought close behind the battalions forming the first wave; that is, at a distance of 80 to 100 meters. Both waves went over the parapet, and the second got to their normal distance on the advance, and resumed the formation in small, single columns.

The organization in depth was as follows: first battalion conquered first objective, second battalion crossed the line occupied by the first, and went for the second objective; third battalion crossed both objectives when a third had to be reached, and attacked its particular objective. The crossing of the lines takes place in single file at the most favorable places, which are specially mentioned in the order which the battalion commander, who is actually marching ahead of his battalion, has to give. When the line has been crossed, the battalion deploys and marches in formation for the attack.

As for the liaison between the artillery and infantry, it has been suggested that as the artillery that actually works on the first objective is always provided with good O. P.'s, and with observers in the advanced trenches, it is practically useless to have the first line of infantry accompanied by a liaison party from the artillery. On the other hand, the artillery, with a longer range, which has to support the infantry whose mission is to carry the second position of the enemy, has no view, or only a bad one, on that position. It should, therefore, detail liaison parties to that infantry and so on from the remotest artillery to the infantry pushed furthest to the front.

[Offensive Fighting. By Major Donald M. McRae, Infantry Reserve Corps, U.S.A. 96 pages, 19 figures, 4½ x 6 in. *J. B. Lippincott*, Washington Square, Philadelphia. Price $2.00 prepaid.]

The author of this very instructive little book was formerly a major in the Canadian Infantry, having served with the Canadian Expeditionary Force for two years before he returned to the United States upon the entry of his own country into the war. During a year of his service at the front he was in command of all the minor operations of his brigade. He later served

as instructor at the British Trench Warfare School, Bexhill, England. He is thus admirably qualified to treat the subjects of which he writes.

The book was written with the idea that it should cover all the new subjects that an infantry officer, up to and including the grade of major, has to know—those matters which are developments of trench warfare, and which are therefore not covered by the old manuals and texts. Its scope is indicated by the titles of the chapters: I. Mine Crater Consolidation; II. Trench Raids; III. Patrols and the Control of No Man's Land; IV. Front Line Observations; V. Co-operation Between Infantry and Artillery; VI. Infantry in Attack; VII. Trench Routine; VIII. Notes on Use of the Prismatic Compass.

All of these subjects are treated in an interesting, as well as instructive, manner. Each operation is described in clear, simple language, and in sufficient detail that a comprehensive grasp of the matter may be obtained by any one familiar with the elements of organization and tactics. The plates add materially to the clarity of the explanations.

In trench warfare it is the junior officer—the platoon leader—upon whom much of the work and the responsibility rests. It is this officer and his immediate superiors who will find Major McRae's book of the greatest value. Under modern conditions, even more than formerly, it is of the utmost importance that all ranks should be familiar with the details of all operations. With this idea in view, the book presents the different subjects in such form and length that the officers use them as the basis for lectures to their men.

[On the Deployed Formation of the Infantry. *Kungl. Krigevetenskaps-Akademiens Tidskrift,* Dec, '17. 2400 words.]

The author emphasizes the importance of the individually thinking soldier within the limits of a given task. The aim and the problem ought to further the adaptability of both command and troops and to prevent a stereotyped training of certain forms. The platoon and its detachments should be trained to utilize every advantage which the situation and the ground offer, even without the interference of the company commander.

The German platoon is divided into groups (detachments) formed of 8 to 10 men, each group under a commander. The Swedish platoon is divided into two squads and each squad in two half squads, which latter division is not very advantageous on account of unsuitable distribution of commands. According to German experiences in this war, such a group commander must have the ability of acting independently within the objective of the platoon, and in attacks must lead his detachment up to the enemy under the cleverest possible use of cover of the ground. He must strive to keep his group firmly in hand, co-operate with the side groups during fire and advance (retreat), conquer objects in the field useful for points of support for his own and his neighbor's advance, etc. In short, special care must be given to the training of the sub-commands within the platoon, that they may be equal to the tasks of open warfare. In trench warfare, the exigencies in this respect are often still greater.

The author further treats the problem of the placing of the different commanders and sub-commanders, direction of the line, the form and mode of advance and firing, etc. The different commanders will be at such points that they can best lead and direct the activity of their men.

[The Evolution of Attack and Defense. By Col. F. N. Maude, C.B., R.E. *Army & Navy Gazette,* Aug 31, '18. 1500 words.]

An article giving the development of the present "elastic defense" of the belligerents on the Western front. Briefly, the development of artillery forced the sapper to abandon his attempt to gain protection for the defenders of a position by depth under the ground. So much vertical cover was required that the defenders could not get up in time to halt the attack, after the preliminary bombardment was finished. So the system of "elastic defense" was evolved, namely a fortifying and cutting up of the area exposed to attack in such a manner that the attackers could not pass over this ground without disorganization and serious loss of time. This gave the defense time to concentrate reserves which drove back the attack.

—Tactics—Co-operation with Aircraft

See also

AERONAUTICS—TACTICS—CO-OPERATION WITH INFANTRY

FIELD ARTILLERY—FIRE (Article: "Lecture on Artillery")

FIELD ARTILLERY—TACTICS—CO-OPERATION WITH OTHER ARMS

—Tactics—Defense

[German Principles of Command in the Defensive Battle in Position Warfare. *Infantry Jour.,* Oct, '17. 2700 words.]

Infantry commanders must see that their troops in the line continue their work on their positions even during the fighting.

Gaps between defensive works must be commanded by fire from the rear and the flanks, and at night and in misty weather should be guarded by outposts.

Reserves must be concealed and so distributed as to avoid unnecessary losses. Front lines should be held by weak garrisons when the fighting is in an open country which affords little cover.

The foremost trenches must be converted into shell-hole positions when they are subjected to the preparatory heavy artillery fire of a hostile attack. In fighting in such shell-hole positions it is not advisable to strengthen the fighting line or to reinforce it continually. The maintenance of these foremost positions is not accomplished by a rigid defense, but by the successful employment of counterattacks.

Weak garrisons holding the foremost trenches must avoid places where the bombardment is most severe, by advancing, moving to the flank or towards the nearest supports. The detachments in shell-holes must keep in touch with each other in order to prevent the enemy from establishing small nests in the firing line

INFANTRY—Continued

whose continuity has been broken by any movement of part of its garrison. Every infantryman must realize that the most certain means of repelling an attack are his own rifle fire, hand grenades, and bayonet. The artillery is of great assistance, but is not of itself sufficient to repulse a strong attack.

Should the enemy succeed in entering the trenches, the artillery must cut him off from the reserves which are following him up, rifle fire must stop his further advance, and trench mortars and bomb-throwers must keep him under fire while he is consolidating the position. Counterattacks must be delivered at once without further orders, and the enemy must be annihilated to the last man by the use of the hand grenade and bayonet in hand-to-hand fighting. If the counter-attack is successful the front line must be placed in a state of defense and the garrison reduced to its previous strength. These tactics cause the fighting to take place not in, but for, the front line.

Should the garrison of the foremost battle zone be unable to eject the enemy or hold him, a combined attack should be made by the general reserve. The attack should be delivered in waves in extended order, and supported by machine guns pushed forward in echelon, by bomb-throwers, trench-mortars, infantry guns and artillery. The decisive factor in the success of an attack is the selection of the right moment for the employment of the reserves; they should not be brought up prematurely. Should an immediate attack not succeed, the position can only be retaken by a methodical attack.

The frequent relief of the infantry is undesirable as the change prevents the troops from becoming familiar with the position and diminishes their keenness in working to improve it. The confusion resulting while a relief is being effected is often the cause of ground being lost.

Searching and sweeping fire with H. E. shell against groups of the enemy's guns are, as a rule, useless. This fire with gas shells is very useful for putting artillery out of action for the time being but is of no value for counter-battery work which aims at the destruction of the hostile battery. When the trenches are from 165 to 220 yards apart, barrage fire should fall on and close in front of the enemy's trenches. Trench mortars, bomb-throwers and infantry must keep the enemy's jumping-off trenches under fire when barrage fire directed upon them would be dangerous to our infantry. The barrage will then be directed so as to cut off the enemy's foremost assault waves and supports. When the trenches are more than 330 yards apart the barrage must follow the progress of the enemy's attack.

Artillery action against the enemy's tanks is of particular importance in the repulse of an attack. Destructive and barrage fire against hollows, roads, and the enemy's positions will often stop tanks by its very intensity. Infantry guns and close range guns which fire with direct laying are equipped with a special projectile for use against the tanks which may penetrate our lines. Heavy howitzer batteries should be detailed to engage tanks which may enter marked zones in front of our lines.

Before the actual defensive battle it is necessary greatly to increase our air forces—airplanes, balloons, and anti-aircraft weapons—because the first objective of the enemy's attack will be to secure mastery of the air.

Pioneers are not to be employed on tasks which the infantry is capable of performing. Pioneer and Minenwerfer companies and searchlight sections are commanded by the division pioneer officer. In a defensive battle the Minenwerfer have a special task to perform in engaging tanks.

—Tactics—Instruction and Training

[Tactical Exercises for Infantry—French Army. By Col. Francisco Echaguey and Col. Juan Garcia Benitez. *La Guerra y su Preparación*, Nov, '17. 2800 words. 5 photographs. 8 figures.]

At attack exercises by troops of the Fourth and Sixth Armies, one by a company and two by a battalion, the latest tactical rules were demonstrated. Tactical development is a consequence of the constantly increasing proportion of artillery, the changing infantry armament, and the perfection of fortifications, which tends to make the Infantry a special force for siege warfare.

COMPANY EXERCISES

Owing to its limited fire effect and the decreasing inportance of long range fire, the rifle is gradually being replaced by more effective weapons. These are the machine gun, the hand grenade, the automatic rifle, and the grenade rifle. Each section is now armed with a fixed number of these weapons. The employment of the section as a unit is frequently done on the battlefield, which has become a multiplicity of small objectives, such as strong points, cover points, machine gun nests, and batteries. Each company has four machine gun sections. The automatic rifle has been adopted in place of a light machine gun, because of its superior mobility. In attack, the grenade rifle is more of a defensive weapon, and as such can replace the automatic rifle. The light machine gun requires 13 men to serve and transport it, and is required to change positions often in a defensive line.

Everything is conducive to an attack developed on a depth of 150 meters and consequently to the delivery of a short, intense, destructive fire. This result is obtained by the use of the hand grenade, the automatic rifle, and the grenade rifle. The rifle cannot entirely disappear, and in many cases it is necessary to assist the action of a small group which must work rapidly, maintaining flexibility. The bayonet must not be forgotten either. All infantry men must know how to throw the hand grenade, so that casualties on the grenadier squads can be quickly replaced. In each battalion there is a platoon of special bombers, who are most adept in the art, and who, in attacks, comprise the mopping up squad.

Hand grenades are of two or three types for attack. They are rather small, and each grenadier carries 25 in a heavy canvas belt around the waist. The range

of the ordinary man, throwing these grenades, is from 25 to 40 meters. The effect of a hand and gas grenade is rather limited and to overcome this limitation the grenade rifle is used. This ranges up to 250 meters, and fires a much deadlier bomb. It's effective range after explosion is 25 meters. The grenade rifle is fired from a kneeling position with the rifle butt resting on the ground. The grenade explodes 5 seconds after being fired.

The automatic rifle fires 40 rounds per minute. It weighs 9 kilos and is carried and fired by one man. Its mechanism is the same as that of a machine gun. Two additional servants, an ammunition carrier and a No. 1, who places ammunition discs in position, are necessary for the gun. No. 1 marches on the right of the gunner, the ammunition carrier in the rear. A company contains 32 grenadiers, 16 automatic riflemen, 16 rifle grenadiers, and 40 assistants to these riflemen. The rest of the company is armed with the rifle. These men are divided equally among the four platoons. The mopping up squad and eight grenade rifle squads of two rifles each remain at the disposition of the battalion commander.

It is estimated that three automatic rifles deliver an amount of fire equal to one machine gun, or 30 to 36 ordinary rifles.

At Maison de Champagne, a grenadier squad of 48 men threw 10,000 hand grenades in three hours and a quarter. Picked grenadier platoons have accomplished great deeds on various occasions. The training is careful and tedious, and picked men must be physically strong, calm, cold-blooded, and possess a natural aptitude for throwing grenades. All members of a company carry a short bolo.

COMPANY EXERCISE—DEFENSE

Situation

The enemy has entered a company sector of between 400 and 500 meters, on the advance observation line only. The enemy artillery, not knowing its infantry position, has ceased firing.

The problem is to take advantage of this critical moment by launching a counter-attack and drawing the enemy out of the position he is organizing.

Dispositions

Six or eight automatic rifle squads open and maintain fire on the enemy. The rest of the company advances and drives him out. After doing this, observation posts are established and maintained by squads.

OFFENSE

Situation

A battalion has assaulted and wishes to continue their advance. It can move over the ground covered by the barrage and 400 to 500 meters in addition.

Dispositions

Reconnaissance is made to the front. Each company detaches a section for this purpose, and the grenadiers and automatic riflemen of these sections advance in line, the grenadiers flanking the automatic riflemen. All advance by short runs, or jumps, from one depression or shell hole to another. The four grenade riflemen follow behind the center of the section on a second line behind the chief of section. They are the chief of section's artillery. Battalion machine guns are in the rear on the flanks, to prevent a counter-attack.

The duty of the automatic riflemen is to keep the enemy down, so he cannot assume a firing position, and so that the hand grenadiers can get close enough to work. An incident in this attack would be the appearance of a hostile machine gun. (The Germans require a machine gun to be taken from its shelter and put into action in one minute.) The grenadiers halt and take cover. The grenade riflemen open fire at a maximum range for precision and effect. One well placed hand grenade will silence a machine gun. All cover must be used.

1st Exercise

To reduce a strong point, whose position is or should be known. The attack is in three phases: bombardment, approach, and mopping up.

1st Phase: 32 grenade rifles bury the point with bombs, assisted in this by the battalion machine guns which are invisible. For this purpose, the 37 mm. gun for Infantry is also used. It is followed up by a platoon of hand grenadiers.

2nd Phase: Four squads of automatic riflemen advance in line.

3rd Phase: Hand grenadiers assault rapidly and mop up.

This was followed by automatic rifle firing exercises on targets in a trench. Both stationary and disappearing targets were used. The automatic rifle squad advanced by short runs, firing from holes in the ground whenever the targets appeared. At the end of this exercise the German light-maxim machine gun was examined. It weighs 10 kilograms, and has a 100 round belt and a small 3 liter water jacket.

2nd Exercise

There was a preliminary action to illustrate the difference in fire effect between the old and new organizations. Two companies of a Senegalese regiment were placed on the firing line, one armed with rifles and the other with the automatic rifle, the grenade rifle, the hand grenade and rifles. The former fired 16 rounds in one minute, and the latter fired at its highest rate for one minute. The contrast was astonishing. The barrages of hand and rifle grenades were plainly visible. The exercise was an attack by a Senegalese battalion of six companies with ball ammunition on a defensive position, consisting of three trench lines, completely organized. The front of attack was about 500 meters.

The first two trench lines are assumed to be practically annihilated and the ground over which the advance is made is supposed to be covered with shell holes.

Two companies are in the first assault, with two in reserve. The first two companies each form two attacking waves; 20 paces between waves, men at five pace intervals, with a supporting wave 200 yards in the rear, marching in lines of small columns. The special troops in each wave march between these columns with the battalion grenade squads and mopping up squads.

INFANTRY—Continued

The advance under simulated fire is at the rate of 20 paces per minute. The reserve companies are formed and march in line of columns, taking cover as much as possible. The battalion commander is between the assaulting group and the reserve group. The machine gun company is at his immediate command. He has with him all liaison agents, and a detachment of sappers with tools to build a hasty shelter. This group must be kept under cover, showing its position to friendly aircraft by a pennant or piece of cloth.

The friendly artillery drops a barrage on the trenches, which is maintained until the attack is 150 yards from the trenches, when it lifts. As soon as the first trench is reached, the mopping up squad cleans out all enemies there and in the communication trenches. The grenade rifles open fire on the third line, the hand grenadiers paying particular attention to any strong point disclosed by the enemy. The battalion machine guns keep up a supporting fire from the flanks. The infantry cannon destroys enemy machine gun posts. An airplane flying at 600 meters altitude keeps the higher commanders informed as to the state of the advance at all times, signals being exchanged by smoke and light bombs. When the observer can give the infantry information of a new line occupied by the enemy, he marks this line in colored pencil on a map and throws the map to the infantry. The map is placed in a weighted metal container to which a long cloth tail is attached. This attracts attention while going thru the air. Other airplanes flying at a higher altitude keep the General Staff advised of the progress of operations.

As soon as the third trench line was considered captured, two strong points in the rear of this line were attacked with the automatic rifle, artillery cannon, and grenade rifle, and finally the grenadiers were thrown against it. As soon as the first lines had completed their work, the reserve companies moved against the second position and formed for its attack.

This ended the exercise, and the eight battalions formed and passed in review in line of section columns ping up squads formed in the rear of the column.
on a two company front, with machine gun and mop-

[The Training of Infantry for Trench Warfare. *Kungl. Kriksvetenskaps-Akademiens Tidskrift,* Jan '18. 4600 words.]

The question of the training of infantry for trench warfare is important, and at the same time difficult to solve. In answering it the fact that training for open warfare is the main object ought to be emphasized. Consequently the time for training in trench warfare cannot be so extensive as might be desired. Besides it seems anything but easy to prepare a place for such exercises within the present time of training and to make these exercises fit in the program. Specially adapted grounds, special material and equipment would be needed. These are very expensive without giving desired results when on takes into consideration how little such exercises correspond to reality.

In general, it is more important to be familiar with attack against and defense of fortified positions, before the fighting has taken the character of trench warfare,than to let trench warfare in its own sense receive the first place in the training program. Exercises in trench warfare cannot, for several reasons, be executed with larger infantry forces on each side than a battalion or a company. The fighting about fortified positions is more possible to execute with the spirit of open warfare. However, trench warfare and its exigencies must be prepared for and thought over. In connection with the training for trench warfare many questions arise, among others whether the war and peace organizations of the infantry ought to be changed according to the experience of the war. It is most desirable to answer this question as soon as possible; it is the war organization which serves as model for the peace organization.

We have instructions on fighting about fortified positions in general as well as during trench warfare. These instructions are, of course, not infallible, and they might be supplied with additions from the experiences of the present war when these are sufficiently sifted and stabilized. It is probably in view of such experiences that provisional instructions for the training of infantry in trench warfare in companies during 1917-18 have been issued.

The instructions in question aim at training in trench warfare, but they are limited to individual training of the platoon and the company, and are laid down in rather general terms.

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scents to dugouts) and tunnels, the execution of different kinds of revetments, the management of boring machines, drainage, etc.

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The main thing in exercises on a field of obstacles is the rapidity and the agility with which the obstacles are surmounted, not the uniform and simultaneous execution.

It would doubtless be desirable that each infantry garrison should dispose of two strongly fortified positions (or parts of such) situated opposite each other, each part so large that it corresponds to approximately the front of a company at full strength. Such constructions ought to be made carefully and according to preconceived plans, in order to have requisite durability. The upkeep should not cause either heavy work nor much expense. It might be more important to have a small amount of well constructed positions than a greater amount of defective ones. The distance between the corresponding positions (main firing lines) ought to allow sufficient space not only for advanced listening posts and their connecting trenches, but also for smaller trenchworks and for shell craters which are to be occupied and arranged for defense during the exercises. The positions ought to be in a dry part of the field with satisfactory arrangements for draining. However, such constructions on the present training fields of our troops ought not to make the fields less suitable for the main training of our troops for open warfare.

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The ejectors of liquid fire which are alloted to the infantry are of comparatively small type. They are used for the destruction of the defense of trenches and connecting trenches, etc., and also for combatting hostile block houses, where the ejector should be brought unnoticed from the flank or from the back while the crew of the block house should be kept busy with machine gun fire.

The ejectors must advance under the protection of storming patrols, immediately followed by infantry in order to utilize the effect.

The trench mortar will combat at short range objects which, on account of their small size, cannot be brought under the fire of long range artillery, or which the artillery has not been able to discover, or cannot combat on account of the short distance from their own positions. Such objects are trench mortars, machine gun nests, flanking constructions, points of observation, etc.

After careful ranging, fire must be opened as a surprise. The success must be rapid, thru rapidity of fire and accuracy of aim, because the mortar will soon attract strong hostile fire. The mortar is not convenient for a continuous fight from one point. Usually only one problem can be solved from one position. It is possible to change such a position, even under difficult circumstances, by the aid of infantry.

According to our instructions, the company will be trained like the platoon if circumstances allow it; relief must be the object of special training. Further training in the execution of smaller attacks, often in combination with hand grenade patrols, should be undertaken. And finally suitable men should receive instruction in the use of Very pistols and such signals within each company. The company might be used for attack from a fortified position with smaller objects in view, which would not need a deeper penetration into the hostile position, such as driving off hostile troops which had secured lodgment immediately in front of the position, and to straighten our own lines, etc.; in short, to gain local advantages.

The grouping of a company for execution of such an attack ought to be adjusted to circumstances just as in open warfare. The instructions for the grouping of the company in open warfare are, in fact, very elastic and might advantageously be applied to trench warfare.

The frequent use of the words "attacking wave" and "waves" leads to the impression that it might be convenient to form, especially during attacks in trench warfare, one platoon after the other in long thin lines. Only in exceptional cases ought such advances to be made. Lacking the grouping in depth, the different units will be mixed up and the personal influence of the commander will be limited. Instead the platoons, eliminating necessary reserves, ought to be placed by the side of each other to be used against a certain part of the hostile position which is to be attacked. The company commander should always dispose of reserves, of which hand grenade patrols should form a part.

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INFANTRY—Continued

The advance under simulated fire is at the rate of 20 paces per minute. The reserve companies are formed and march in line of columns, taking cover as much as possible. The battalion commander is between the assaulting group and the reserve group. The machine gun company is at his immediate command. He has with him all liaison agents, and a detachment of sappers with tools to build a hasty shelter. This group must be kept under cover, showing its position to friendly aircraft by a pennant or piece of cloth.

The friendly artillery drops a barrage on the trenches, which is maintained until the attack is 150 yards from the trenches, when it lifts. As soon as the first trench is reached, the mopping up squad cleans out all enemies there and in the communication trenches. The grenade rifles open fire on the third line, the hand grenadiers paying particular attention to any strong point disclosed by the enemy. The battalion machine guns keep up a supporting fire from the flanks. The infantry cannon destroys enemy machine gun posts. An airplane flying at 600 meters altitude keeps the higher commanders informed as to the state of the advance at all times, signals being exchanged by smoke and light bombs. When the observer can give the infantry information of a new line occupied by the enemy, he marks this line in colored pencil on a map and throws the map to the infantry. The map is placed in a weighted metal container to which a long cloth tail is attached. This attracts attention while going thru the air. Other airplanes flying at a higher altitude keep the General Staff advised of the progress of operations.

As soon as the third trench line was considered captured, two strong points in the rear of this line were attacked with the automatic rifle, artillery cannon, and grenade rifle, and finally the grenadiers were thrown against it. As soon as the first lines had completed their work, the reserve companies moved against the second position and formed for its attack.

This ended the exercise, and the eight battalions formed and passed in review in line of section columns ping up squads formed in the rear of the column. on a two company front, with machine gun and mop-

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[The Training of Infantry for Trench Warfare. *Kungl. Kriksvetenskaps-Akademiens Tidskrift,* Jan '18. 4600 words.]

The question of the training of infantry for trench warfare is important, and at the same time difficult to solve. In answering it the fact that training for open warfare is the main object ought to be emphasized. Consequently the time for training in trench warfare cannot be so extensive as might be desired. Besides it seems anything but easy to prepare a place for such exercises within the present time of training and to make these exercises fit in the program. Specially adapted grounds, special material and equipment would be needed. These are very expensive without giving desired results when on takes into consideration how little such exercises correspond to reality.

In general, it is more important to be familiar with attack against and defense of fortified positions, before the fighting has taken the character of trench warfare,than to let trench warfare in its own sense receive the first place in the training program. Exercises in trench warfare cannot, for several reasons, be executed with larger infantry forces on each side than a battalion or a company. The fighting about fortified positions is more possible to execute with the spirit of open warfare. However, trench warfare and its exigencies must be prepared for and thought over. In connection with the training for trench warfare many questions arise, among others whether the war and peace organizations of the infantry ought to be changed according to the experience of the war. It is most desirable to answer this question as soon as possible; it is the war organization which serves as model for the peace organization.

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INFANTRY—Continued

stalwart men familiar with hand grenade fighting. (*Author's note:* storm patrols are hand grenade patrols used for attack. Hand grenade patrol is a term of a more extensive sense than "storm patrol"). The strength of such a patrol is usually five to eight men and commander. They are used for difficult tasks or where the strongest resistance might be expected. If possible, the attack ought to be supported by machine guns, grenade throwers and light mine throwers, even when no greater artillery preparation is intended to take place.

When a company is going to execute an attack, the requisite number of storm patrols as a rule advance simultaneously with the first lines, mostly in front, sometimes within the lines. The formation of the storm patrol depends upon circumstances. Sometimes in a thin line, sometimes in Indian file, sometimes as a common patrol. Obstacles will influence the formation.

The advance of a company is as a rule like any other advance. Several lines thus follow each other, tho the distaces between them are shorter. First come the storm patrols, followed by or sometimes united with the first line, then platoon reserves, company reserves, and finally the units destined for construction of fortifications and the transportation of certain materials, etc. The reason for the small distances between the lines in depth is to prevent the possibility of a hostile barrage between the lines.

The objective ought to be selected carefully. It may for example be in the first hostile trench line or beyond. In the latter case, the storm patrols (storm troop units, first lines) rush forward until the goal is reached, leaving to the succeeding lines the mopping up of the hostile trenches and their connections. On the other hand, the advance must be stopped when the goal is reached. Beyond this only storm patrols ought to be sent forward. In special cases a company may be given the aid of engineer troops for blasting purposes, etc.

Besides a good morale of the attacking troops, an intimate knowledge of their own and a careful inspection of hostile positions gained by the aid of maps and air photos are necessary for success. Preliminary training on practice grounds is very convenient and necessary.

In defense, the platoon and company reserves of the companies in the first line are usually formed by storm troop units who have the task of ejecting hostile forces.

A battalion of a regimental unit will be found, according to the formation of the regiment, either in the first line or as regimental reserve, just as in fighting in general. During the present war there are cases where a regiment has been formed with a battalion in the first line, a battalion in the second line as a first reserve (in preparation), and a battalion in the third line as a second reserve (at rest).

The object of a battalion commander in the first line is to defend the front alloted to him. He controls all specially built-in armaments, such as machine guns, grenade throwers, light mine throwers, etc. If the supply of machine guns allows it ,the battalion reserve ought to be provided with them.

According to our general instructions, the battalion commander ought to control the service of information and all communication arrangements, so that in case of danger barrage fire may be ordered and executed all parts of the battalion alarmed, and the commander of the regiment as well as units behind and on the flanks informed. He must often inspect the preparedness and the different alarms of the subdivisions of the battalion and keep well informed of the whereabouts of the enemy and changes within the hostile positions. He strengthens his position according to the instructions of the regimental commander, and is responsible for the maintenance and replacing of munitions and provisions, as well as giving special attention to sanitary conditions and the health of his men.

The connection with the artillery should be arranged in a fully satisfactory way. An artillery officer ought to be at the disposal of the battalion commander. The former ought to keep in touch with his artillery commander and give the battalion commander necessary advice on artillery, and thru him the battalion commander gives his orders to the artillery. The latter ought to act on the reports from his subalterns, in order that suddenly appearing targets may be put under fire, if this has not already been done by the artillery observers themselves.

The relief troops are to receive up-to-date sketches of the positions on relieving their comrades.

The commander of a first reserve (in preparedness) must, in case of attack, throw the enemy back thru rapid and energetically executed counter attacks, when the first lines have been entered. For this purpose he must keep himself well informed of the course of the fighting in the first lines. Besides it is his duty to hold, with the possible aid of neighboring units, the rear lines or their most important points until reserves have time to come up. He must also be prepared to take charge of the defense of flanking positions, in which case he must be familiar with the necessary measures.

For the solution of these questions the forces of the battalion have to be carefully grouped. The battalion commander must have thought out carefully all possibilities and gone thru them with his subalterns.

As regards the battalion of the second reserve (at rest), its time should be used to re-establish the physical as well as the spiritual vigor of the troops, in repairs of arms and equipment, and in further training in trench as well as open warfare.

The battalion commander should also prepare for the execution of larger attacks as well as action in the flank positions. The possibility of a rapid alarm must be insured against.

Should a regiment be grouped in only two lines, *i.e.*, battalion (or battalions) in the first line, and regimental reserve, the battalion commander of the regimental reserve will act according to the instructions for the previously mentioned reserves (in preparedness and at rest).

The duties of a commander of a regiment consist

in the most satisfactory arrangement of the tactical, technical and hygienic exigencies. For this purpose he ought to form a plan for the strengthening of the position, according to which the work is regulated and executed. An engineer officer as well as engineer troops ought to be put at his disposal. In case of necessity the commander forms his own infantry pioneer divisions. He ought to train his regiment for the solution of all the different problems of trench warfare. When not in action, training fields should be constructed for the purpose and special courses be given in the handling of the different material.

Finally it is one of the most important tasks of a commander of a regiment to counteract the depressing influence of long continued trench warfare and to maintain the morale of his troops. In this respect exercises now and then in open warfare are of great value.

—Tactics—Shock Troops

[Shock Troops. *Kungl. Krigsvetenskaps-Akademiens Tidskrift,* Feb, '18. 1000 words.]

The daily press accounts of the war operations contain the information that so-called shock troop divisions exist. It appears, however, that they are not organized in larger units than battalions. Manifestly trench warfare had created the need of specially organized shock troops. The circumstances under which long continued struggles about fortified positions are fought, have developed the hand-to-hand fighting and its technique, especially the hand grenade fighting, into very special directions. It appears that the specially organized shock troop divisions have been developed thru the courses which had been instituted for training in hand to hand fighting.

Such troop groups are surely élite troops. It is a question whether they might be used to advantage in open warfare. During different periods of the history of wars and their development, there have been élite troops in the infantry, during other periods they have been found less convenient and the infantry has been trained more with a view of unity. Of course, there may be occasions when shock troop detachments may be very useful even during open warfare, but it is not easy to foresee their use at any special point. If they are going to operate as units, *i.e.,* in battalions and companies, the difficulties will be less on the assumption that the roads allow the use of motor cars, bicycles, etc. Using them in smaller units (in platoons, squads, etc.) or only as storming patrols, it might be more difficult to get them to the desired points or objects in time.

Another question is where such troops belong. To divisions, brigades or regiments? Would it be more convenient to have a shock troop battalion in the division, or a shock troop company in each of the regiments of the division? Complete answers to this and equal questions are not easy to give.

The shock troops having been developed thru special courses for training in hand-to-hand fighting, seem to have kept the character of such and at the same time to have been developed to élite troops specially designated to solve difficult problems during trench warfare. Officers and under officers of the infantry are sent to take such courses in order to serve as teachers within their own units.

It appears that specially organized shock troop units should be of a higher quality than the hand grenade patrols of the companies (storming patrols, storming troop units). They are said not to be used in closed units (battalions, companies, platoons), but their object seems to be about the same as the hand grenade patrols of the companies, even if in a higher degree. In case of having to gain more difficult objects, shock troop units or a certain number of storming patrols would be alloted to the infantry unit in question. Such an arrangement is naturally somewhat inconvenient, but might be more or less adjusted in the long continued trench warfare, where as a rule a long time is employed for preparations and to allow officers and men to get their bearings; where extensive measures of scouting can be instituted, and where combined exercises beween the infantry units in question and the shock troops allotted to them may take place. Circumstances are otherwise in open warfare.

As the name implies, shock troop units (storming patrols) are principally meant to be used in attacks, where they are used against such parts of the hostile position as are to be broken thru, where there are specially difficult objects to gain, or where the strongest resistance might be expected. In addition to this comes the use of the supporting armaments of the infantry where such are allotted to the shock troops. Storming patrols may be kept in reserve at companies to be used for counter attacks as well as common defense, and commanders to whom specially organized shock troop units have been allotted may divide them into reserves when the situation exacts it. The reason why shock troop units are principally used in small units or as storming patrols is probably the heavy casualties in the violent fighting of trench warfare if they should be used as companies or battalions. The special shock troop units of the infantry probably form a comparatively small percentage of the infantry forces.

Those who are trained in shock troop units ought to be perfect infantry soldiers (first class men). Their training primarily aims at individual efficiency in the use of hand grenades and other arms used in hand-to-hand fighting, together with instruction concerning their construction and effect. Further, shock troops are used in attack and defense in combination with ordinary infantry, in practice exercises in different situations and circumstances such as attacks on hostile trenches and thru two or more lines of such trenches, in counter attacks, in fighting hostile machine gun positions, in turning off counter attacks, etc. The preparations for the use of shock troops in attacks must be specially careful in scouting and inspection of ground (aided by maps and aerial photographs), in deciding the direction and objects of the detachments (patrols), in the issuing of orders as well as sketches for the execution, etc. Whether and to what extent specially organized troop units ought to exist in times of peace it is not possible to decide without a thoro investigaion and a careful consideration of all the factors by which it is influenced.

INFANTRY—Continued

—Use of in European War

See also

EUROPEAN WAR—WESTERN THEATER (Article: "Impressions of a Visit to the German Front in Belgium")

[Under Fire in a Front Trench for 20 Hours. From a German Description. *Krigsvetenskaps-Akademiens Tidskrift,* Apr, '18. 1200 words.]

Under the headline "What Soldiers Go Thru the Day of a Big Battle" a German paper of the war press gives the description of the actions of a small German detachment under violent fire and constant enemy attacks.

Scene: a crossroad on the highway between Langemarck and Zonnebeke. In one of the angles of this crossroad a concrete protection, called "Staigerhaus." Persons in action: Reserve Lieutenant Durr, commander of the detachment, 1 under-officer, 11 rifles and the service of a machine gun (5 Gefreiter); the rest of the men are sent to bring food or are used in the lines of communication. The action takes place on the 22nd of August, 1917.

3:45 a. m. Still dark. Violent enemy artillery attacks.

6:25 a. m. The drumfire undiminished; 100 m. to

5:30 a. m. The real drumfire follows, tremendously violent, going back and forth like a roller which crushes everything. Private Knodler wounded. The machine gun damaged. To the right and the left light balls go up. Lieut. D. does not feel that the situation warrants a signal-report of the enemy attack, because no Englishmen are yet in sight.

4:25 a. m. The drumfire undiminished; 100 m. to the left a cloud which rises in the air. No gas. Private Maule wounded by a grenade splinter.

6:30 a. m. The outlook reports 3 tanks slowly approaching out of the smoke on the road at a very short distance. The first one is firing away with revolver gun and machine gun, the second one with machine gun only, at "Staigerhaus" and at the neighboring detachment. Lieut. D. divides his rifles on the 3 monsters. The first tank is hit in the side and ceases firing; the second one catches fire and also stops firing; the third one stops, turns and disappears.

6:40 a. m. The crews abandon their tanks and seek cover at the road. Three or four of them fall, hit by German bullets.

7:15 a. m. Comm. officer reports the victory on a report card; spirit excellent.

7:40 a. m. English infantry attacks in dense masses. The lieutenant fires the first light ball. The attack has a wrong front, gets into our fire from both flanks and is defeated.

8:00 a. m. Renewed enemy drumfire. The remnant of the defeated infantry and some men of the tank-crews retire. Lieut. D. and a private patrol the right which has suffered heavy losses. Under strong artillery fire the two dig out a buried German machine gun and bring it in to Staigerhaus while the artillery duel still continues.

8:10 a. m. Second great infantry attack, this time with right front. The English have learned something. The Germans shoot as if possessed. The British are unable to advance.

8:20 a. m. Staigerhaus under fire, observed by English fliers. Big calibers. No hit. The enemy moves by the right and left and tries an encircling movement on both flanks. The detachment Durr fires, covering three sides. Private Fahrbach shoots without support; the one aimed at falls. Another private makes observations thru the fieldglass.

8:25 a. m. To the right at this side of the road two enemy machine guns gallantly take position. All our guns concentrate their fire on them.

8:45 a. m. Lieut. D. reports "The enemy tries to gain ground in the center, right and left but is compelled every time, thru the regrouping of my excellent troops, to retire." The service-crew of one of the machine gun already under fire; one man retires with the machine gun.

9:30 a. m. Our own machine gun destroyed. Under-officer Sontheimer and Private Rau run to one of the tanks and bring back a Lewis gun, revolvers, etc. Great enthusiasm! Lieut. D. patrols the left. The detachment still on their posts.

10:15 a. m. Third written report: "The position held entirely."

10:45 a. m. The taken English machine gun receives a bullet in the gas mechanism; is repaired.

11:15 a. m. Our own artillery keeps the ground in front of the crossroad well under fire. The morale heightened.

11:47 a. m. An English flier comes. All signals are retired. The whole deetachment to Staigerhaus. Low spirits.

11:50 a. m. English artillery fires at the stranded tanks. Aim too short, everything in dust and smoke. The situation disagreeable.

12 o'clock noon. The German artillery opens an imposing "Vernichtungsfeuer" at the ground in front of our position. Spirits high. The English are ready to attack, but do not do so.

12:30 p. m. Lieut. D. with Private Maule patrols the right wing under enemy fire, finds a friend from the time of his one year service in the army who is almost covered with earth and seriously wounded; he is dug out, bandaged and sent back of the lines. Short pause for dinner.

1:45 p. m. Suddenly violent artillery fire which does not do any damage. The enemy keeps comparatively quiet during the afternoon, but is very much awake. The tank crew is still hidden on the incline behind the road. To the right the machine gun is spitting now and then. Scattered artillery fire in the field; some infantry fire here and there. The encircling movement of the enemy has made progress. Durr and his men solemnly promise each other not to retire under any circumstances and to break thru, if they would be surrounded.

6:00 p. m. Both friend and enemy dead tired and long for the night.

7:00 p. m. To the left strong drumfire from our own artillery. The German counter attack is developing. The Schwabians (the men in Durr's detachment)

clearly see the storming lines. They themselves use the opportunity to seize the fittings of the tanks. They come under the fire of the crew. Our men enter the steel protected cacrriage. They find two dead. One of them is still in his seat at the revolver gun; he has 8 bullets in the head and the neck. Three machine guns are wrenched out of their sockets; munitions, provisons, revolvers and sundry things are seized; the men retire to their posts. The English shoot miserably; one man is wounded, however, but brought into safety.

10:00 p. m. Lieut. D. makes a detailed written report on the situation, ammunitions, arms, number of the forces and encloses sketch.

11:00 p. m. Relief arrives. Much to relate. The commanding officer is given the iron cross, first class, and is duly complimented. He is now in for a furlough.

11:15 p. m. The detachment returns to the second line under terrific enemy curtain fire. No casualties.

INTENDANCE SERVICE

See

SUPPLY AND TRANSPORT

INTERNATIONAL LAW

See also

ESPIONAGE

NEUTRALITY—VIOLATION OF

INTRENCHMENTS

—Bomb-proofs

[Deep Gallery Shelters. By Col. P. S. Bond and Lieut. R. D. Leisk, Engrs., N.A. *Professional Memoirs,* Jan-Feb, '18. 3200 words. Illustrations.]

Men cannot remain continuously in open trenches under modern artillery fire; yet they must be close at hand to man the trenches to oppose or deliver an assault. These conditions demand adequate shelters giving easy access to the fire trenches. The use of such shelters gave rise to the development of the attack tactics employing the strong artillery preparation and the time-barrage fire during the assault. These tactics are now employed by both sides, so the need for adequate shelters is greater than ever.

Each shelter should have two, or preferably three, outlets to afford quick and easy egress and to prevent the likelihood that all exits will be blocked. In order that the relative amount of work involved in the construction of the outlets may not be too great, the shelter should not be too small. On the other hand, they should not be too large, so that their capture or destruction or the blocking of their outlets would involve a great number of men. They should generally accommodate not fewer than 16 or 18 and not more than 35.

The construction of dugouts has now been quite thoroly standardized. This standardization in materials and methods is one of the most important developments in the art of constructing deep shelters. It is not absolutely rigid, but is analogous to the standardization in building construction and has greatly promoted rapidity and efficiency.

The inclined shafts of the standard gallery have a clearance of 6 feet vertically and 2 feet 6 inches horizontally. The interiors are 6 feet high and 8 feet wide in the clear. This allows a tier of bunks on each side and a passage 2 feet 6 inches wide.

Dugouts may be divided into two classes according to their mode of construction. One type is constructed by excavating over the whole area to be occupied by the dugout—the old "cut and cover" method. The other type is the result of a distinct mining operation. In this a shaft is sunk and rooms excavated without removing the ground above, forming the so-called cave shelter. There is a growing tendency to abandon all except the cave shelter type. In fact the latest instructions direct that this shall be done. Shelter in the fire trench is usually desired for protection against shrapnel and shell fragments, machine gun and rifle fire only. If more than this is required, it should be sufficient to resist direct hits of the heaviest class of projectiles ordinarily used against such shelters. to-wit: 210 cm. (8½ inch) high-explosive shell.

The principal objection to the deep shelter on the front line has been the delay in getting men out of them in time to meet an attack delivered just as the barrage fire lifted. With all the exits in the front line trenches the dugout becomes a death-trap if the enemy arrives in the trench before the men can emerge. In order to permit leaving the shelter even after the trench has fallen int othe hands of the enemy, a third opening should be built, when possible, leading to some outlet other than the trench containing the two main entrances. This last exit should be carefully masked.

The advantages of the deep gallery shelter are numerous. The most important ones are the increased safety during bombardment and the fact that work on the dugout may proceed both day and night without interruption, something that is seldom true of the cut and cover type. Cave shelters are readily constructed without arousing the enemy's suspicions, provided the earth is carried away unobserved. Excavating can be carried on and sand bags filled by day as well as by night, the bags being carried away after dark.

Enough dugouts should be constructed in each sector to shelter the garrison, generally one man per yard of front. The dugouts should be built in groups and should be interconnected. Each should be connected by a speaking-tube to a sentry post from which the ground to the front can be observed. Entrances should be far enough apart so that they will not be blocked by any single shell burst. They should be well concealed and, if possible, should be provided with good head cover and a bursting course of broken stone. The top of the trench is usually strongly reinforced just above the entrance to the dugout. The entrance slopes at about 45 degrees except in the case of dressing stations, where the slope is reduced to 30 degrees. The main gallery is generally under the parapet side of the trench but at such a depth that the trench is not weakened thereby. There should be a chimney for ventilation.

There should be a minimum of 20 feet of virgin earth above the dugout Where there are shell holes on the surface the depth should be greater. When the water level prevents excavation to the proper depth reinforcements must be placed above the roof. These may consist of layers of logs, cement blocks, or concrete.

INTRENCHMENTS—Continued

The inclined entrances are provided with wooden steps having 1 foot tread and rise. They do not lead directly into the dugout, but into a short passageway (about 3 feet long) which connects the entry with the dugout, is provided at the bottom of the entry shaft.

Drainage must be carefully looked after. The entrances to dugouts must be so constructed that water flowing along the trench will not seep thru into the chamber. A roof to the dugout will prevent miscellaneous seepage. If water gets into the dugout it will ordinarily be impracticable to drain it off. In such case a sump hole and some form of pump must be provided.

Special care is taken to provide for the defense of the dugouts. Wire entanglements in front of the entrances are made especially strong and are well covered by cross fire from machine guns. Bomb nets are placed to protect the entrances. Means are also provided for the interior defense of the shelters. These generally consist of the bomb-traps already mentioned, and of obstacles to keep grenades from rolling into the main part of the dugout. As a protection against gas, blankets or curtains impregnated with neutralizing solutions are hung in the entries.

In excavating one of these dugouts the descents are begun simultaneously. Parties work eight hour shifts and the average progress is six to seven feet per day. Earth is removed in sand bags, in small trucks running on wooden rails, or in boxes sliding on the floor of the entry shaft. All precautions are taken to conceal the work from the enemy, especial care being taken in the removal of the earth. A dugout with a 20-foot roof and 50 feet between entrances can be completed in 15 days in ordinary soil.

—Use of in European War

[Shell Holes. By Lieut. Dubois. *Revue Militaire Suisse,* Jan, '18. 2400 words. 2 photographs. 1 map.]

(Description of the use of shell holes by consolidation for protection.)

Each shell hole holds two or three or more men who fight together and protect each other, being inseparable during the combat. Secrecy as to the shell holes occupied is maintained and no movement is allowed during the day. When the fighting begins it is from hole to hole allowing great chance for individual initiative.

The losses from artillery are much less than where trenches are used as there is no plain objective for the enemy to fire at. With men so far out in front occupying the shell holes protection from surprise is complete.

ITALIAN FRONT

See

EUROPEAN WAR—SOUTHERN THEATER

INVALIDES

[The Invalides: Past, Present, and Future. By F. Ashford White. *United Service Mag.,* Apr, '18. 2300 words.]

A decree has been issued by the French Government ordering the utilization of the Hôtel des Invalides as a hospital for the homeless disabled of the present war. It is to be subject to the rules of military hospitals, and the Medical Service is to take precedence over all other occupants of the building in the right to secure additional space. It will be open to army and navy men of all ranks who cannot receive from their families the special attention they need, also to men requiring long treatment and unable to care for themselves without assistance.

No one will question the practical and praiseworthy character of this decision. The original purpose of the building was to furnish a home for disabled veterans, of whom there were as many as 4000 in 1818 and 3410 in 1831. (Details of the interior economy of that time given.) At the time Napoleon's remains were brought from St. Helena to the Invalides, the most of the residents were veterans of the Napoleonic wars. The number of residents dwindled to 642 in 1875 and to only 34 thirty years later.

The Invalides has always been a picturesque feature of Paris; and in the present war the court has been the storage and display place of captured German trophies. By the decree the original purpose is again to be served.

ITALY

—Aeronautics

See

AERONAUTICS—ITALY
DIRIGIBLES—ITALY

—History

See also

EUROPEAN WAR

[The Military History of Italy, 1815 to 1918. By T. Miller Maguire, M.A., L.L.D., F.R.Hist.S. *United Service Mag.,* Sept, '18. 5000 words.]

The varying vicissitudes which have befallen the Italian Army in the present war make it interesting to note the difficulties under which they have fought, and, by a comparison with the past achievements of gallant Italian armies which have won renown and victories, be encouraged to place confidence in the ultimate success of the present situation.

A survey of the situation for the past century finds Italy badly torn to pieces in 1815, as the result of the Final Act of the Congress of Vienna, June 9. 1815. Previous to this date Italy had been divided into many little principalities and petty states. During Napoleon's triumphal campaigns he had succeeded in creating a Kingdom of Italy. The continental portion of the Kingdom of the Two Sicilies was under Napoleon's brother, Joseph Bonaparte, King of Naples, and when he went to Spain, it was ruled by his brother-in-law, Murat. In spite of the fact that France controlled Italy at this time, it really formed the basis of the Italian Kingdom as we have it to-day, and all the wars which followed the fall of Napoleon have been for the unification of Italy after its dismemberment by Austria, who not only re-divided the land into petty states and gave the Pope the church lands which would keep Italy separated, but also put Austrian princes on the thrones of these various petty states, with the exception of Victor Emanuel, who was the

only Italian-born ruler, and at this time King of Sardinia.

The struggle for unification commenced in the year of dismemberment, 1815, but it was not until 1848 that popular discontent and yearning for republicanism swept Europe and started the leaven working in Austria. In 1849, Charles Albert, King of Sardinia, took advantage of this and attempted to throw off the Austrian yoke, but was badly defeated in the campaign of Novara, and abdicated in favor of his son Victor Emanuel, who asked an armistice pending a treaty of peace. As the result, Venice was reoccupied, Rome seized, and Sicily conquered by Neapolitan troops.

In 1859, after the Crimean War, Austrian rule seemed firmly established over northern Italy in Lombardy and Venetia, as well as Austrian influence governing in Rome and Naples. Thru the offices of Count Cavour, France was interested in a movement whereby she and Italy would form an alliance to throw off Austrian domination from northern Italy and crush her military power. Whereas Italy's reason was a valid one, France simply regarded the Austrian occupation of Lombardy as a constant menace to the safety and independence of Piedmont. In a brief campaign the Austrians were defeated at Magenta, June 8th, and again at Solferino, June 24, 1859. Thus Italian hopes of freedom ran high, when on July 7th, for some unexpected and unknown Austrians which left them in possession of Venetia, in spite of his boast to free Italy to the Adriatic. Naturally, disappointment was general. Savoy and Nice were annexed to France, Lombardy and Venetia west of the Mincio, except Mantua were given to Sardinia, and that kingdom was also further enlarged by the addition of the states of Tuscany, Modena, Parma, and Romagna, all of whom joined by popular vote. In spite of the disappointment of the armistics, and the subsequent parcelling out of territory, Sardinia was growing larger and more powerful and was preparing for further efforts to win the goal of her ambitions—the freedom and unification of Italy.

The next military opportunity came in 1866, when Prussia and Austria were at war. When the invitation was extended Sardinia to join the Prussians against their hereditary enemies, the Austrians, they readily assented. However, they were badly defeated at the battle of Custozza, June 24, 1866, and had to retire across the Mincio. The Prussians more than made up for their defeat at Sadowa, and as a part of the agreement which followed, Austria had to cede Venetia to Italy.

The principal remaining menace to the growing Kingdom of Sardinia which was the cornerstone of the present Kingdom of Italy, was the Papal States and so-called Patrimony of St. Peter, which included lands on both sides of the Tiber, and also the City of Rome. In 1870 Gen. Cadorna forced an entrance into the city where he was received with wild exultations by the people. The question of consolidation with the Kingdom of Italy was put to a plebiscite and carried by a vote of 130,000 to less than 2000, and Oct 11th, Gen. La Marmora entered the city as Viceroy. Italy was now united, with the exception of Trent, Trieste, and San Marino.

San Marino deserves a word of mention, in that it is probably the oldest republic in the world, having been established in the 4th century. This little state lies just south of Rimini on the Adriatic, has a population of 12,000 and keeps an army of 1100 men.

Subsequent to the unification of Italy proper as constituted when she entered the present conflict in 1915, Italian power had been greatly augmented by her acquisitions in northern Africa, Tripoli, and Cyrenaica, which had once belonged to their rival, Carthage, and had later passed into the hands of the shrewd Teuton, Genseric.. Other developments had made Italy a power of first rank and a considerable ally in the present conflict. With a geographical expanse of 111,000 square miles, and a population of 35,000,000, Italy was able to put into the field an army of 310,000 men, with a reserve of 250,000. Up to the present the Italian Army has passed thro many vicissitudes of fortune. Whereas the great retreat from the Isonzo in the fall of 1917 was a severe disaster, one must not lose sight of the brilliant campaign which advanced them to that point, or of the counter offensive work which halted the Austrian advance and now bids fair to throw them back upon the fields from which the Italian retreat started.

Inasmuch as Italy entered the war to regain her lost provinces of Trent and Triest, any truce which overlooks this and subsitutes any compromise for the main objective which led her into the war is only a bid for further dissention and ultimately another war.

—Meteorology

See

METEOROLOGY

—Military Topography of

See also

EUROPEAN WAR—GENERAL NOTES ON OPERATIONS BY THEATERS—SOUTHERN THEATER

JAPAN

—Army

[The Mikado's Army. By a Military Correspondent. *Sphere*, Mar 23, '18. 1300 words. Illustrated.]

The Japanese maintain a stricter secrecy with regard to their military affairs than any other nation of the world, and even the German year-books, tho giving minute and up-to-date knowledge of other armies, tell but little of the Japanese.

We know in a general way that there are some twenty-two divisions of active troops (*Geneki*) nineteen of which are raised in Japan, two in Korea, and one in Manchuria; that behind each active division stands a reserve (*Yobi*) division and a landwehr (*Kobi*) division; and that a division comprises 12,500 men and 36 guns on a peace footing and 18,700 men and 54 guns on a war footing. There are thus forty-one first line and nineteen second line divisions, a field strength of approximately 1,500,000 men. Behind these are the vast reserves that can be drawn from a nation of 55,000,000 population or 70,000,000 including depend-

JAPAN—Continued

encies. About 500,000 to 600,000 young men reach military age each year and but about 120,000 are taken in the active army. This admits of very careful selection and results in recruits of the highest quality.

The Japanese are an inventive military people. At Port Arthur, Gen. Nogi used nearly all of the mechanical devices brought into such prominence by the present war, such as hand grenades, smoke clouds, 11-inch mortars, and trench catapults. He also practised the "limited offensive."

The Japanese have been active in the development of heavy artillery. Her heavy field batteries include a 4.1-inch gun and 4.7 and 5.9-inch howitzers. Her garrison artillery includes even heavier mobile guns, such as the 5.9-inch gun and the 7.9 and 9.4-inch howitzers. The latter are far more powerful than the notorious German 8.2 inch howitzer.

In leadership, Japan has a large number of experienced general officers remaining from the Russo-Japanese War, and Japan believes in experience—in old but fit officers.

The Japanese have one peculiar feature. Any man of any grade in the army can communicate directly and confidentially with a special section of the General Staff. The sins of omission of commanders are thus liable to be exposed by keen juniors.

—Army—Instruction and Training

See also

OFFICERS—INSTRUCTION AND TRAINING OF (Article: "Japan, Regulations for Combined Maneuvers")

—History

See also

EUROPEAN WAR
RUSSO-JAPANESE WAR

—Military Policy of

[Committee for the Study of Foreign Affairs in Japan. By Col. T. E. Herrera de La Rosa. *La Guerra y su Preparación*, Sept, '17. 700 words.]

(An article dealing with the Japanese imperial order creating a committee consisting of the Prime Minister, certain general officers and admirals, for the study of foreign developments in the arts of naval and land warfare, and the institution of proper changes in the Japanese Army and Navy in order to keep pace with foreign nations.)

JAPANESE-RUSSIAN WAR

See

RUSSO-JAPANESE WAR

JONES, John Paul

[The Scottish Buccaneer. By Percy Cross Standing. *United Service Mag*, Apr, '18. 1800 words.]

(A very brief account of the life of John Paul Jones. Born July 6, 1747, he went to sea at the age of 12. He crossed to America several times and in 1773 inherited the property of his elder brother in Virginia. Upon the outbreak of the Revolution he offered his services to the new government of the United States. His principal work was to harry the coast of Scotland. His principal action was that of the *Bon Homme Richard* and two other vessels against the *Serapis* and the *Countess of Scarborough*. In 1788, John Paul Jones entered the Russian naval service as rear-admiral of the Black Sea fleet and fought well against the Turks. He resigned within a year. He drifted back to Paris, where he died, July 18, 1792.)

JULIUS CAESAR

[Julius Caesar and the War of Position—Spanish-Massilian Campaign of 49 B.C. By G. Suchet, Lt.-Gen. *Rivista di Artiglieria e Genio*, Oct-Nov, '17. 4000 words.]

There were still two Pompeian legions in Southern Spain, under Terentius Varro. After some wavering, he had definitely cast his lot with Pompey, and in his service was displaying great energy but a total lack of tact. His province was already inclined to favor Caesar, who had formerly been proprætor there; and his severities and confiscations (extending even to the treasurers of the temples) consolidated this feeling. He had gathered a considerable land and naval force, amply supplied, at Cadiz.

Caesar started south with 600 horse, leaving his two legions to follow. As he approached, submissions began to come in, and Pompeian garrisons declared for him. Even Cadiz joined in the movement, driving out the commander of the garrison. One of Varro's own legions declared publicly for Caesar, while Varro himself was reviewing them; with the remaining one he sought to take refuge in Italica, but that city closed its gates against him. He then surrendered to Caesar, by whom he was well treated and given civil employment.

Caesar then went to Cadiz. After arranging for the government and defense of the province, he embarked, with his two old legions, in Varro's ships, for Tarragona. From here he proceeded by land to Marseille, where his presence was urgently needed.

Marseille was a naval base and fortress of the first class, with complete dockyards, strong fortifications and powerful artillery. When Domitius Ahenobarbus assumed command, his first care was to seize all vessels in the vicinity, to strengthen his own fleet and to render it difficult for Caesar to improvise one. He hoped thus to retain full command of the sea. Caesar had given orders for fitting out twelve ships at Arles, under Decimus Brutus; and had entrusted the land attack to Trebonius, with three Gallic legions.

Trebonius had opened a formal siege, first commencing the construction of two colossal mounds (*agger*) before the walls. The high command of the city walls and the power of the artillery of the defense made it necessary to build them as much as 25 m. high, and to commence them at a great distance from the walls, so that the work was very slow.

Meanwhile Brutus' ships were ready and took station at a little group of islands just off the harbor. A greatly superior fleet came out to attack him but was driven back with heavy loss.

News now reached Marseille that the legate Nasidius, with sixteen ships sent by Pompey from Greece, had forced the passage of the Straits of Messina and

reached Toulon. The Massilian fleet joined him there, and the combined force returned to attack Brutus, who met the mhalf way. Brutus, as in the previous battle, used an open formation, and sought to close with the hostile ships and take them by boarding. But the enemy had learned caution, and his ships supported each other too well for this. At last, an awkwardly executed maneuver caused a collision between two Massilian ships; Brutus skillfully availed himself of this opportunity to break the line. Nasidius, with the left wing, was driven out to sea; the remnant of the Massilian fleet took refuge in the port and was shut up there.

On the land side, it had become evident at once that ordinary siege works were inadequate. The artillery of the defense had not only great range, but great power; some of the ballistae threw iron shod beams twelve feet long. All working parties had to be when close to the walls, against incendiary projectiles.

Near the *agger* on the right, it was found necessary protected by very heavy shelters against these, and, to construct a special work—a heavily built brick tower, with a strong overhanging roof and a screen of cables toward the enemy. By a system of screws, this roof was raised as the walls were built up; the sixth story dominated the wall.

A breach was finally made, by use of a shelter (technically known as a *musculus*, or "rat") 20 m. long, moving on rollers, and with a roof which was proof against any possible attack. The defenders then asked for an armistice, agreeing to surrender unconditionally to Caesar upon his arrival. Trebonius accepted, and discontinued his attack; whereupon the garrison treacherously made a night sortie and set fire to most of the siege works. Trebonius promptly set to work to reconstruct them; famine and pestilence threatened the city, and another truce was asked and granted. Caesar arrived a few days later, and the surrender was accomplished. Two legions, and most of the fleet, were left at Marseille; Caesar, with his two old legions, went to Italy, where he prepared for a new campaign against Pompey in Macedonia.

This is one of the most interesting of Caesar's campaigns. The siege of Marseille was a most brilliant operation, but it was in Spain, and more especially at Lerida, that the genius of the commander and the excellence of his troops were most conspicuous. In less than six months, including winter and spring, he had marched almost the entire length of Gaul and Italy, then back thru southern Gaul to Spain, and there conducted a most strenuous and active campaign. The service of information was excellent thruout. The Pompeian troops were the best he had yet had to meet; but his own had excelled them, both on the battlefield and in marching and maneuver.

"KARLSRUHE," Operations of the

[The Cruise of the "Karlsruhe"; from the diary of Capt.-Lieut. Austa. *Naval* (Russian) *Review*, July, '17. 3500 words]

(This article is a portion of the diary which its title indicates. It is an interesting narrative, altho only a small portion of the story has reached this country. The account published starts with Oct 26, 1914, which was only a few days before the destruction of this cruiser. During this period she appears to have captured but one merchant ship.

The destruction of the *Karlsruhe* is reported to have occurred on Nov 4, 1914, in lat. 10 deg. 7 min. N., and long. 55 deg. 26 min. W. The author states that immediately after supper, as the executive was just starting from the table for the bridge, an unexpected violent explosion took place, followed at once by the failure of the electric light system and a heavy list to port. The ship sank quickly, the crew, less some casualties, being picked up by the *Rio Negro*, a consort ship which was following the *Karlsruhe* at the time. This last ship proceeded directly to Kiel in Germany via Norway, arriving at its destination on Dec 4.

The ships captured by the *Karlsruhe* and its consort ships, captured vessels forced to accompany it, are stated by the author to be as follows:

				1914	
Bowes Castle	British	4650	tons	Aug	18
Strathroy	"	4356	"		31
Maple Branch	"	4338	"	Sept	3
Highland Hope	"	5150	"		14
Indrani	"	5706	"		17
Cornish City	"	3814	"		21
Maria	Dutch	3804	"		21
Rio Iguassu	British	3817	"		22
Farn "	"	4393	"	Oct	5
Nicoto de Larrinaga	"	5018	"		6
Lynrowan	"	5000	"		7
Cervantes	"	4635	"		8
Pruth	"	4408	"		8
Condor	"	3053	"		11
Glanton	"	3021	"		18
Hurtsdale	"	2752	"		23
Vandyck	"	10328	"		26
Total		76609	"		

valued by the author at more than 15,984,000 marks.)

KITE BALLOONS

[Progress in Aeronautics. By Major H. Bannerman-Philips. *United Service Mag.*, Oct, '17. 3600 words.]

It is one of the many curious facts in the history of aeronautics that in spite of the valuable service that the kite-balloon had rendered the Italian and Spanish forces in Africa, and its regular employment by the Germans in maneuvers since 1895, it should have formed no part of the equipment of the British Expeditionary Force in 1914, and should have been sc little used by the Allies in the early part of the war. This is the more remarkable because the captive spherical balloon had been found very efficient by the British in their various small wars. They possessed a number of the best spherical balloons ever owned by any nation, but these could bear no comparison as regards usefulness with the kite balloon. The latter

KITE BALLOONS—Continued

can be used in winds of almost twice the strength that the former will stand. It is moreover far steadier and more manageable under any circumstances. Being cylindrical in shape, it can be held by a cable attached under the forward end. The suspension of the aerostat is so contrived that it is inclined at an angle approximately forty degrees towards the wind, and the car is slung at a convenient distance below by running rigging. By means of a ballonet with an aperture open to the wind, the shape of the aerostat is maintained whether the gas diminishes in volume or not. An automatic valve prevents any excessive expansion of the gas. At the after end of the balloon is one of its most useful features, the air rudder which steadies it in the wind. This prevents it from swinging violently to and fro and disturbing the observations of the occupants of the car. The kite-balloon has a narrow jib-shaped sail on either side, increasing the lift of the balloon by aero-dynamic action after the manner of a kite.

It is, of course, possible to send up a single observer in a basket sustained by a system of kites. But kites are more tricky, the lift cannot compare with that of the kite-balloon and neither the kite-supported basket nor the airplane offers so good a platform for the observer as does the car of the kite-balloon in the direction of artillery fire. The facility for the use of the telephone in connection with observations is one of the great advantages possessed by the kite-balloon as compared with mobile aircraft. There is another reason for the use of a stationary overhead observation platform in preference to the airplane when watching for movements of the enemy. Its steadiness permits of the use of high power field glasses, while the same observers can be employed day after day over the same stretch of country. They thus get to know its every feature, so that very slight alterations of aspect or indications of movement can be detected.

LANGLEY FLYING MACHINE

[Langley's Flying Machine. By Carl H. Butman. *Aviation*, Nov 15, '17. 2400 words. Illustrated.]

Samuel Pierpont Langley, the inventor of the flying machine, has been long in coming into his own, but at last his name has come to stand for the pioneer in aviation. His man-carrying "aerodrome," built in 1900-03, was flown in 1914, thereby vindicating the claims Langley advanced; first in 1896, when he flew his steam model successfully, and supplemented in 1903, when his gasoline model flew, altho his two attempts to launch the large machine in the latter year failed. It has been established since that this machine will fly under its own power as originally designed and built, and even carry additional weight. The original machine, surnamed the *Buzzard*, was returned to its birthplace, the Smithsonian, in March, 1904, after the conclusion of the experiments, and there stored for ten years. On April 2, 1914, it was shipped to the Curtiss factory at Hammondsport, N. Y., for reassembling and tests. Upon the receipt of the complete flying machine at Hammondsport it was reassembled. The first trials with floats, which consisted of two shallow draft pontoons forward and a float aft, proved that the machine would plane very well, with the original planes. The original power plant not only drove the machine over the water, but lifted it out completely and started it on a flight in spite of the additional dead weight of the pontoons, a weight never anticipated by the inventor. Soon after the first flight, some readjustments were made on the machine and the tests were continued on June 2, with far better results, altho no lengthy flights were made, for it was thought better not to overtax the engine, shaft and bearings. The additional weight of the pontoons added 340 lbs. to the total weight of the machine or an increase of 40 per cent. In the hope of offsetting this additional weight, Dr. Walcott agreed that a Curtiss 80 h.p. engine with a single tractor screw be fitted, since its line of thrust is practically identical with that of the Langley twin propellers. On installing the power plant the engine was moved up and backward and other minor adjustments were made. On Sept 17 two flights were made. On Sept 19, after some more adjustments had been made in balancing and in the angle of incidence of the wings and substituting another propellor, flights were made between 1000 and 3000 feet in length. It was not flown high in the air for fear that it might be destroyed by some accident. This machine, which was completed in 1903, proved by its trial flights that it was as stable as our modern airplanes. The Langley type is known as a tandem monoplane; its frame is built, guyed, and balanced with the greatest scientific accuracy. Its power was derived from a 5-cylinder, water cooled, gasoline engine, which developed over 50 h.p. at 950 r.p.m., and operated two propellors from a main shaft by bevel gears. On the only two occasions that this machine was tested, Oct 7 and Dec 9, 1903, it failed to operate properly and fell into the water. Mr. Langley's interest first was manifested in 1887 when he undertook to demonstrate the possibilities of and the conditions for transporting in the air a body heavier than the air. Success in actual flights first attended his efforts on May 6, 1896, when one of his steam models made two flights at Quantico, Va. In spite of the statement that he had made that "I have brought to a close the portion of the work which seemed to be specially mine, the demonstration of the practicability of mechanical flight," in 1898 at the request of President McKinley he willingly undertook the task of building a man carrying machine.

LAUNDRIES, Military

See also

BATH TRAINS (Article: "Bath, Disinfection Trains and Field Laundries of the Austro-Hungarian Army")

[Notes on a Divisional Laundry. By Capt. R. E. Stradling, R.E. *Royal Engineers Jour.*, Dec, '17. 800 words. 4 plates.]

(A description of a complete Divisional Laundry erected in the field. The plant consisted of an unloading shed and disinfecting rooms, a wash-house 35 ft.

by 27 ft. 6 in., two drying rooms 20 by 23 ft., two mending rooms 21 by 20 ft., an ironing room 44 by 20 ft., a sorting room 14 ft. 8 in. by 20 ft., a clean clothes store room 29 by 20 ft., and an engine room 25 by 20 ft.

Disinfecting was arranged by wet and dry steam in coils. Arrangements were made so that the disinfected clothing could not come in contact with the untreated. The wash house contained three washing machines. two rinsers made on the spot, and two hydro extractors. The drying rooms were heated by a steam coil over which air was driven into the chambers by a fan. The mending and ironing rooms were made as light as possible. Shelving was provided in the store room for clean clothes.

The article with the accompanying plates gives a very good idea of the structure and should form a valuable guide for any similar work. It is impracticable to attempt any complete description of the plant without the plates.)

LEATHER

—Subsitutes for

See

Shoes and boots

LIBRARIES, Medical

[The Medical Library in Wartime. By F. H. G. *Bulletin of the Medical Library Association*, Oct, '17. 1500 words.]

The profusion of war literature in all fields is very great. It is possible that, in aid of army medical officers and of medical librarians, the *Index Medicus* will shortly issue a "war supplement" containing the literature of military medicine, classified under special subdivisions.

Among the good medical periodicals are *The Military Surgeon, Journal of the Royal Army Medical Corps of Great Britain*. These two will probably suffice for American readers. Of special interest to naval officers are the *United States Naval Medical Bulletin*, the *Journal of the Royal Naval Medical Service* (London), and the French *Archives de médecine at de pharmacie navales* (Paris). About the only continental (European) journals available and of importance are the *Archives de médecine et de pharmacie militaires* (Paris,) *Caducée* (Paris) and the *Giornale di medicina militare* (Rome).

(Follows a list of books on medico-military subjects.) An exhibit of books and pictures relating to military medicine will soon be made in the Library Hall of the Army Medical Museum, Washington, D. C., under the direction of Col. C. C. McCulloch, Med. Corps, U. S. Army, Librarian of the Surgeon General's Office.

—Military

[Books for All Men in U. S. Service Are Provided by the Library War Service of the American Library Association. Published by request of the American Library Association.]

At the request of the War Department Commission on Training Camp Activities, the American Library Association has undertaken to supply reading matter to the men of our army and navy, wherever they may be.

This service extends to 39 large camps, to small camps and stations, to vessels, hospitals, transports, and overseas. It is the aim of the service to send books to every point where U. S. soldiers, sailors, and marines are stationed.

During the last seven months, the Library War Service Headquarters at Washington reports 1,271,800 books shipped to 39 large camps where there are trained librarians and 36 library buildings; 185,000 books to 211 small military camps, posts and stations; 130,000 books to 111 naval stations; 30,000 books to 111 vessels; 20,000 books distributed among 81 army and navy hospitals; 200,000 books shipped from dispatch offices for use on transports and overseas.

This distribution makes a total of approximately two million gift books in service thru nearly 600 different agencies. In addition to these, 350,000 new books (largely technical) have been purchased and are in use.

Books and magazines of all kinds are available: good stories; technical books on military tactics, electricity, machine shop work, trench fighting, aeronautics, automobiles, gas and such subjects; poetry; biography; books about the war; in in fact, all books that men like to read.

Books will be found in A. L. A. camp libraries, in Y. M. C. A. and K. of C. huts, in charge of Red Cross secretaries and chaplains, in hospitals, barracks, mess halls, on ships—wherever U. S. army and navy men are in service.

If there are no A. L. A. books in any place where men are stationed, all that is necessary to obtain them is to send the following data to the Library War Service Headquarters, Library of Congress, Washington, D. C.

Name and address of camp (or vessel).

Kind of camp (or vessel).

Approximate number of men in camp (or on board).

What agencies are supplying reading matter and to what extent.

What local library, if any, is co-operating.

How many and what kind of books are needed.

How many magazines are needed.

Where will reading matter be housed.

Who should be notified when books and magazines are shipped.

Will he arrange for the circulation of this reading matter thruout the entire camp (or vessel).

There is no red tape about getting the books; men in charge will be asked to keep simple records, instructions for which are furnished with each library.

LINES OF COMMUNICATION

See also

Roads, Military

LOGISTICS

See also

Supply and transport

MACHINE GUN

See also

Browning machine gun

MACHINE GUN—Continued

—Ammunition

See also

MUNITIONS—MANUFACTURING FACILITIES—UNITED STATES (Article: "U. S. Machine Gun Production, etc.")

[New Anti-Airplane Cartridges. *Army & Navy Jour.*, Mar 9, '18. 368 words.]

The present war brought forth a new kind of ammunition for airplane use in the form of special cartridges containing bullets for armor piercing, tracing and incendiary purposes. With the progress of the war the more vital parts of the airplane were protected with light armor, so that it became necessary to introduce the armor-piercing bullet. As the gasolene tanks were particularly susceptible to incendiary explosion, it was necessary to procure a bullet containing an inflammable substance, ignited upon discharge, which would carry the spark or flame into the tank upon piercing it. As the target, the enemy airplane, was within fighting range for only brief moments at a time and as there were no means of determining the fire effect, as on land, a tracer bullet containing a bright-burning composition, which would indicate the path of the bullet in daylight as well as in darkness, and thereby allow the aim of the machine gun to be corrected, was introduced. The composition is set on fire upon discharge and the bullet flies thru the air as a bright spark, plainly visible to the machine gun operator. All of these cartridges are of small rifle calibers—caliber .30 or thereabout. The three-tenths of an inch diameter and short length of this bullet left little space therein for the armor-piercing element or for the tracer or incendiary composition. Nevertheless combinations of armor-piercing and tracer, and armor-piercing and incendiary bullets have been made.

At the outbreak of the war further information was promptly gathered from the Allies and this subject was studied by those responsible for this work in the United States. Of course, on account of the difficulties of the problem none of the special bullets possessed by any country is entirely satisfactory or what might be termed "perfect" in operation. The bullets developed by the U. S. Ordnance Department have been tested on land and from airplanes to see if there is any difference in their performance when fired from a quickly moving airplane in the upper atmosphere and when fired on land. These tests indicate that the United States has developed a class of special cartridges with a performance fully equal to or surpassing that attained abroad.

Switzerland

[The Actual Situation of our (Swiss) Machine Gun Units. By Col. Immenhauser, Chief of the Infantry Division. *Revue Militaire Suisse,* Feb, '18. 4200 words. 6 illustrations.]

I. Organization

The one hundred and twenty machine gun companies that the infantry has had to furnish since the summer of 1915, finished their organization and instruction in November, 1917. It remains to extend to the *landwehr* the process employed for the *élite* and to make of each machine-gun company in the regiment a unit similar to the battalion in the regiment. The Germans have guns of two models, one light and one heavy, in fact so many of the latter that in battle, even if several per regiment are put out of action, still enough remain to throw an effective sheaf before the lines. The light machine-guns are in the company, while the heavies are in the battalion and regiment.

But the Swiss must keep from adopting two kinds. In a small army it complicates matters to multiply models both as regards manufacture and instruction. The Swiss machine gun is used with the cavalry and yet is equally adapted to universal use. It cannot be used in trenches and it takes a great deal of time to set up. What is needed is one type of gun and two types of support, one for combat at distances and one for trench fighting. In the former case the telescopic sight, the tripod support, and the shield are to be used; in the latter case the shield must be so made that it can be used for support, leaving the other parts behind.

For transporting this type of machine gun, one Swiss mountain wagon can carry eight with shield support and enough ammunition for immediate needs without passing the limit for an infantry ammunition wagon. If, beside the machine gun companies with their machine guns and tripods, we could give the battalion of infantry eight machine guns per company equipped with the support for close action, four four-horse mountain wagons and four carts with one horse each would be enough to carry the thirty-two guns and their accessories. Ammunition carts for the machine gun companies could also supply the battalion machine guns. The standard machine gun cart could by a change carry two machine guns and ammunition. When the terrain became difficult or proximity to the enemy no longer permitted the use of the cart the gunners could carry the pieces and the assistants the shield-supports, the ammunition being carried by the horse (unhitched).

To attain the end of two guns per section of infantry (all kept in the machine gun company, however), the machine gun company would have to have four mountain wagons, four carts and twelve horses more than at present, also eight wagoners. Mechanicians should be increased from six to twelve so that each infantry company would have two for its close range guns. An increase of officers and gunners is not necessary, for two non-commissioned officers and eight men from each section of infantry could be instructed in the use of the gun, specializing on close combat, which is less difficult than long distance firing, which latter requires the use of the telescopic sight adn the tripod. One month would be enough to make a good marksman into a fair machine gunner for close work. After this instruction they could be instructed as mechanicians.

II. Instruction

The artillery has always wanted to introduce the use of ranging shots and conduct of fire similar to their own methods, but which poorly consider the nature of the machine gun. Distance from the enemy and character of the arm are quite different in the two branches.

The machine gun must be considered as an independent element of combat. Uniform conduct of fire by several guns at distances less than one thousand meters is impossible. Nevertheless one sees company commanders tolerating conduct of fire by section chiefs, altho the latter can not be heard because of the noise of the nearest gun. The result is that machine guns are dangerously grouped, contrary to regulations which provide thirty paces between guns. The main duty of the chiefs of section should be to keep properly apportioned the tasks of the pieces.

Two men to a gun are eoungh, the gunner and his assistant who acts as observer. More increases losses without any favorable results. The shield only protects two, and if it were made larger it would be more easily seen and more difficult to transport. In target practice, the targets must be large enough so that hits will give the gunner confidence in his power. Targets representing machine guns are useless at distances greater than six hundred meters, because a gun and its two operators are so easily concealed that they would never be fired at at distances greater than that. Targets far away that blend into the landscape may be fired at all afternoon without a hit. This is a useless waste of ammunition. After problems, there should be a discussion of the result with the whole company, and a period for answering questions. Privates, noncommissioned officers and officers should be praised for good work done. Instruction should not end until each member of the machine gun company is capable of carrying out any task without help. Each officer of the machine gun company should be able to take over instantly the duties of an officer of infantry, in fact the lieutenants, before going into machine gun work, should be section chiefs in infantry. Each captain of machine guns must have commanded a unit of riflemen.

[Of Machine Guns. By "Oudeis." *Army & Navy Gazette*, July 27, '18. 1200 words.]

[Automatic Weapons. By Lieut.-Col. De La Bere. *The Journal of the United Service Institution of India*, July, '18. 3500 words. 4 cuts.]

A weapon is said to be automatic when, after once it has been loaded and fired by the operator, it continues to load and fire by inanimate forces, so long as the supply of cartridges contained in its magazine is unexhausted.

The two types are called "automatic or self-loaders" and "automatic firers."

There are four classes of automatic weapons classified as to weights:

1. Machine guns above 25 pounds.
2. Machine rifles from 10-25 pounds.
3. Automatic rifles up to 10 pounds.
4. Automatic pistols about 7½ pounds.

The characteristics of these classes are:

1. Machine guns have a steady mounting and deliver a concentrated fire for a considerable time to long distances.
2. Machine rifles are supported by an attachment (bipod or tripod) near the muzzle. The butt is supported by the firer. They are therefore unsteady and used for short ranges, short bursts of rapid fire on favorable targets. It is a weapon of surprise, invisible and easily carried.
3. Automatic rifles are only experimental at present, but the employment of them by a few selected soldiers per company on the firing line would greatly increase the intensity of fire.
4. Automatic pistols are for offense and defense at close ranges up to 50 yards.

The advantages of automatic weapons are as follows:

1. Celerity of loading and increased volume of fire.
2. Less abstraction on the part of the firer, as he has only the replenishment of ammunition, aiming and pressing the trigger to attend to.
3. Less fatigue on the part of the firer.
4. In certain cases possibly less recoil.
5. Decreased likelihood of detection owing to absence of movement in working the weapon.

The disadvantages are:

1. A greater number and complexity of component parts.
2. Liability to jam or become inoperative owing to failure of the mechanism or entrance of extraneous substances.
3. Heating of the weapon and violent ejection of hot cartridges.
4. In the case of automatic rifles, difficulty in arranging for a satisfactory attachment of the bayonet.
5. Difficulties of ammunition supply.
6. Increase of cost.

All automatic weapons should possess the following:

1. Automatic action whether the weapon be cold or hot.
2. Automatic action not to be violent.
3. Strength of all parts of the automatic action.
4. A reserve of force to overcome increased friction or weakness of recuperating springs.
5. Should the automatic action fail the weapon should be capable of being operated by hand.
6. Action must be positively locked at the moment the round is fired.

Automatic weapons are actuated by the force exerted by the explosion of the cartridge and employ this force in two ways:

1. Recoil operation.
2. Gas operation.

In recoil operated weapons the force of the recoil opens breech, ejects fired case, loads, cocks and fires the weapon, while in gas-operated weapons a small portion of gas carries out the above operations.

The advantages of recoil operated weapons are:

1. More compact than gas-operated weapons.
2. Less recoil, consequently action not so violent.
3. Working parts not so liable to corrosion from residue of gases.

Disadvantages:

1. No reserve force to overcome increased friction.

Advantages of gas-operated weapons are:

1. By regulation of the amount of gas, extra friction can be overcome and energy increased.
2. Ballistics not interfered with.

Disadvantages:

MACHINE GUN—Continued

1. The vent, gas port, cylinder and piston are liable to become coated with fouling and residue of gases, necessitating the cleaning of the weapon.
2. Violent in their action.

In recoil operated weapons, there are three so-called action systems:

1. Fixed barrel recoil used in small pistols.
2. Short barrel recoil.
3. Long barrel recoil.

The advantages of long barrel recoil action are:

1. Less chance of the breech opening before the bullet has left the muzzle, for barrel and bolt are locked longer.
2. Greater weight of recoiling portions absorbing more energy of recoil and by its increased weight possessing greater power of overcoming friction.

Disadvantages:

1. The necessity of a system of trip levers increases the number of component parts required and adds to the weight and complexity of the action.

In gas-operated weapons the following are the ways of using the gas pressure:

1. By means of a small hole near the muzzle and a cylinder and operating rod.
2. By the engraving of the bullet. This utilizes the inertia of a portion of the mechanism. It is simple but makes the weapon too heavy.
3. Utilization of the pressure of gas at the muzzle by placing on it a sliding cap, the blast of gas effecting the automatic action.

The advantages of the last-mentioned system are:

1. The muzzle velocity is slightly increased as the gas is confined and made to act more on the base of the bullet.
2. The action is regular and less violent than in ordinary gas-operated weapons.

Disadvantages:

1. The cap becomes rapidly corroded by the residue of the gas.
2. It is difficult to arrange for the attachment of
Examples of recoil-operated automatic machine guns
a bayonet to a rifle of this type.
are:

(a) Fixed barrel, movable block attached by recoil of the cartridge.

Austrian Schwarzlose

Weight ....49 pounds
Cooling arrangement ....Water
Rate of fire ....300 rounds per minute
Feed ....Belt

Remarks

This gun requires a jet of oil to be projected into the chamber after each round to reduce the skin friction of the cartridge. The gun therefore requires a supply of water for the jacket and oil for the reservoir.

(b) Short barrel recoil.

Maxim

Weight ....60 pounds
Cooling arrangement ....Water
Caliber ....500 rounds per minute
Rate of fire ....Belt
Feed ....303 inch

Maxims are used by Great Britain, America, Germany, Portugal, Switzerland, Turkey, Bulgaria, Serbia, Spain, Brazil, Greece, Italy, and Russia.

Vickers, a lighter form of Maxim

Weight ....28 pounds
Cooling arrangement ....Water
Rate of fire ....500 rounds per minute
Feed ....Belt
Caliber ....303 inch
Used by Great Britain.

(c) Long barrel recoil.

Hotchkiss ....Semi-automatic.........47 mm.
Vickers ....57 mm.
Vickers Maxim....Semi-automatic.........76 mm.

Automatic Machine Rifles. (Recoil principle.

(a) Long Recoil.

Madsen

Weight ....17 pounds
Cooling arrangement ....Radiator
Rate of fire ....300 rounds per minute
Feed ....Hopper of 25 rounds
Caliber ....303 inch
Used by Denmark, Russia, Japan and Sweden.

Automatic Rifles. (Recoil principle.)

Short recoil:

Mauser Model 1900	Braunning
Maxim	Mannlicher
Freddi	Halle
Kjellman	

Long Recoil:

Quist	Browning sporting rifle
Schouboe	

Machine guns acting on the gas-operated principle:

Nation	Gun	Weight in lbs.	Cooled by	Rate of fire per minute	Feed	Caliber inches
U. S. A.	Benét-Mercier	33	Radiator	500	Strips of 30	.303
France, Japan	Puteaux	50	Nil	360	25	.315
Belgium, Great Britain	Hotchkiss	38	Radiator	500	30	.256 & .300
U. S. A.	Colt	40	Radiator	400	Belt of 250	.303
Great Britain	Lewis	26	Radiator	500	Drum of 47	.303

In pistols, the automatic is peculiarly suitable since the energy and weight of the recoiling portion can be kept within reasonable limits.

The advantages of automatc pistols are:

1. Self-loading and rapidity of fire.
2. Ease and rapidity of recharging the magazine.
3. Less recoil and consequently less displacement of aim.

4. Breech remains open when magazine is empty.

A reliable safety arrangement is a necessity for an automatic pistol.

Conclusion

It will be seen that automatic machine guns and automatic pistols are in existence and form part of the armament of practically every nation. Machine rifles are used by many nations and are still undergoing improvements. Automatic rifles are still in the embryo stage.

Machine rifles are peculiarly suitable for cavalry, as they can be carried in a boot and one machine rifle will equal from 15 to 20 dismounted troopers in intensity and volume of fire.

Automatic rifles will doubtless be perfected and some nation will adopt them and the other competing nations will be forced to follow suit.

—Ammunition Supply

[Ammunition Supply of Cavalry Machine Guns. Ramos. *Memorial de Caballeria*, Aug, '18. 1500 words. Diagrams.]

Following table shows apportionment of ammunition in Spanish Service.

Infantry		
In belts	150 rounds.	
Company pack mules	48 "	Total per rifle,
Ammunition carts	40 "	416 1/3 rounds
Divisional Ammunition Column	93 1/3 "	
Mobile depot of Army Corps	85 "	
Cavalry		
In belts	30 "	Total per rifle,
Spare belts	60 "	90 rounds
In combat wagons	None	
Artillery		
In limbers	36 "	
In first echelon carts	96 "	Total per
In second echelon carts	48 "	piece, 372
In Divisional Ammunition olumn	96 "	rounds
In Mobile Depot	96 "	
Cavalry Machine Guns		
1st echelon		
Gun horses	1000 "	
Ammunition horses	2000 "	
2nd echelon		
Ammunition horses	4000 "	Total per
Ammunition carts	5333 "	Machine Gun,
Regimental Train	4000 "	28833 rounds
Mobile Depot	12500 "	

A consolidation of the above tables gives us following for the Spanish Service.

Infantry	416 1/3	Rounds per Firearm.
Cavalry	90	" " "
Artillery	372	" " "
Cav. Machine Gun	28833	" " "

Therefore, allowance for machine gun is seventy times as great as that of any other firearm.

Now, dealing with machine guns alone, make following comparison.

Spanish Cavalry		
1st echelon	3000 rounds	
2nd "	9333 "	Total 12333
German Cavalry		
In limbers	4450 rounds	
In caissons (2nd echelon)	10000 "	Total 14450

This shows an excess in German Service of 2000 rounds per gun over the Spanish; moreover of these 2000, 1500 are in 1st echelon with the guns, and hence available at outset of action.

Now, altho Spanish regulations prescribe 450 shots per minute for their Model 1915 Colt Gun, the author assumes 250 a maximum average in action due to heating, jams, change of objective, change of position, etc. Simple computation gives us therefore fifty minutes as the life of the immediate ammunition supply. This means that at the end of one day's serious fighting, both echelons are entirely exhausted and the matter of supply rests with trains and base.

The author makes use of a simple diagram, showing from rear to front the mobile depot which supplies by trucks the regimental train. From here ammunition goes forward to the 2nd echelon by packhorses belonging to latter organization, thence to 1st echelon by latter's horses, and finally to the guns by hand. A gun on going into action opens at once with the thousand rounds carried on the gunhorses, followed up by the 2000 on the ammunition horses. The second echelon is invariably at a distance remote from the firing line, being charger with the use of the belt filling machines. Empty belts and belt boxes must always be carried back to that point. It is also to be noted that altho the second echelon has its carts, it invariably brings up its ammunition from the regimental train on packhorses.

—Field Use of

[Machine Guns and Infantry. By a Machine Gun Officer. *Schweiz. Monatschrift aller Waffen*, July, '17. 1800 words.]

The machine gun used to be an auxiliary weapon for infantry, cavalry, and engineers, but it has become, in a certain sense, the principal infantry weapon. Its advantageous qualities are concentration of fire, power and mobility.

One of the lessons of the world war is that, whether in position or maneuver warfare, infantry in attack cannot succeed without preparation of artillery, particularly heavy artillery. Similarly, in defense it can succeed only when the fire of its own artillery is more effective than that of the attacker. When the opposing forces have come too close for effective artillery fire, then the preparation is taken over by the machine guns. The infantryman now fights with grenade, bayonet, and butt; the rifle, as a firearm, is used seldom, and only for personal protection. During the artillery preparation it is ineffective, and after that stage there is neither time nor room for its use. The machine gun takes its place.

As with rifle fire, the closer to the target, the greater is the effect. Also, the machine guns must move

MACHINE GUN—Continued

forward in the attack; if they adopt a defensive rôle they fall victim to the enemy's artillery. Since they go forward with the infantry, machine gun companies are now incorporated in infantry regiments, and increased in numbers. The machine gunner must know what the infantryman expects of him, and the latter must know the limitations of the machine gun. Many machine gun officers fail in this respect, chiefly because they are inexperienced and have much to learn about their own weapon.

The machine gun, in a sense, has no tactics of its own. The infantry provides the problem; the duty of the machine gun is to aid the infantry. How this is to be done is, of course, to be determined by the machine gun officer. The machine gun is a weapon of precision. Accuracy of range is even more important than with the rifle. Individual marksmanship is of extreme importance. When it can be avoided the machine guns are not in the infantry line, but on high ground in rear, or on the flank, or in front. Better fire discipline is maintained when the guns are not mixed with the infantry. They are, of course, in close communication with the infantry. On the Somme, the Yser, the Dvina, and in Mesopotamia the terrain has, however, frequently required the guns to be in the line. Where possible the machine gun officer seeks flanking fire and surprise; to await the most favorable opportunities he must often resolutely refuse premature aid to the infantry.

In the machine gun troops there is no place for dilettantism. Each type has its faults in functioning. Since fire is opened only at critical moments, a jam, if it occurs, happens at a critical moment. The personnel must be skillful, courageous, and thoroly acquainted with the weapon. The same applies to the commander. Machine gun troops are exposed, in action, to exceptionally severe losses. To supply reserves, it has been customary to train infantrymen as machine gunners, giving, during the period of active service, a double training. This has not worked well—considering what the infantryman has to learn of the tactics of his own arm of the service, the period of training is not long enough to make the same man a good infantryman and a good machine gunner. Either the period of training must be lengthened or the double training must be abolished. I believe that after this war, whether or not the former course is adopted, the latter will be.

—History

[Automatic Fire-arms. *Schweiz. Zeitschrift f. Art. u. Genie*, Sept, '17. 1300 words.]

The first attempt to increase the efficiency of firearms was along the lines of assembling independent units. The result was the organ-musket of the sixteenth century, which consisted of a number of musket barrels placed side by side and all fired at once. This was used in the Dutch-Spanish war of 1568-1608. It was defective in that an effective gas-check had not been invented, and the whole apparatus was too unwieldy. The difficulty of the gas-check was overcome in 1860 by placing powder and shot in a metal shell which fitted closely in the chamber. The explosion expands the shell against the barrel. When this problem was solved, multiplication of barrels was again taken up. The Requa-battery was a gun of 25 barrels, which could be set at angles with each other, scattering the shots. The gun could fire seven salvos of twenty-five shots each in one minute. It was used in the American civil war. An improved form was the French mitrailleuse of 1870-71, which consisted of 25 to 37 barrels, fired successively. The barrels were parallel.

The Gatling gun, also used for the first time during the American civil war, had greater success. In this gun six or eight barrels were grouped in a circle around a hopper. The barrels were brought successively opposite the opening of the hopper by turning a crank, and the same motion caused the discharge of the piece, the extraction of the empty cartridge, and the loading of the succeeding barrel. One hundred shots per minute could be fired, and these nould be scattered as desired. Later the speed was increased to 400 shots per minute. Each barrel had its own bolt. The Hotchkiss gun was an improvement on the Gatling. In this gun the barrels were revolved by a crank, as in the Gatling, but there was only one bolt, opposite which each barrel was brought before discharge. This gun was widely introduced in navies in the eighties, chiefly as defense against torpedo boats. Later the Nordenfeldt gun was introduced, in which the barrels were stationary, while the bolts were turned and operated by a crank. By the use of five barrels, 360 shots could be fired per minute.

The improved technique of the eighties enabled Maxim to introduce his gun, in which the recoil was utilized to extract the empty cartridge and reload. During the time (1/1000 to 1/100 of a second) while the bullet is traveling in the bore, the pressure of the powder gasses on the empty shell is equal to the pressure on the bullet. During this short time the shell must be so set in motion as to remain intact under the pressure, as to leave the barrel when the powder gases escape from the muzzle, and as to develop sufficient velocity to go back far enough to permit the introduction of another cartridge between bolt and bore. This involves calculation of the force of the bases, and the friction of the shell in the barrel. Maxim solved the problem by having the barrel recoil a short distance with the bolt; the latter was then freed from the barrel, the shell extracted, and a new cartridge introduced. The bolt was then closed by a spring. 600 shots could be fired in a minute. The gun was first used in large numbers at Omdurman in 1898.

A number of other guns functioning on the same principle were then invented. In weapons having short barrels, the bolt is closed by a spring, without other attachment to the barrel, as in the case of the Browning pistol. In longer pistols the bolt is also attached by a jointed link. In the Hotchkiss machine-gun this is avoided by means of a vent which conducts the powder gases to a piston.

[Machine Guns. By Oga. *Memorial de Caballeria*, Oct, '17. 3400 words.]

The name machine gun (ametralladora) is modern but the instrument itself in rudimentary form was in use as early as the year 1342.

Capt. Azan in his work "The First Machine Guns" gives an interesting description of the *Ribudoquines* used in the fourteenth century. These consisted of three or four serpentines bound together and transported on two-wheeled carts drawn by a horse or by two men. They were used both defensively and offensively, the latter use being for the purpose of making breaks in the formations of the enemy.

The weapons in use in the sixteenth century known as *organs* were constructed on the same principle, that of fastening together a number of gun barrels with the idea of discharging them simultaneously. They were mainly intended for the defense of fortified places. In 1598 one Boillot invented a gun that functioned automatically upon the opening of the door or port in defense of which it was placed.

Diego Ufano, a Spanish artillery officer, refers to the employment, during the seventeenth century, of a many mouthed cannon, the barrels of which could be discharged either singly or simultaneously. French, English and Dutch inventors produced many types of guns during the seventeenth century. The most successful appears to have been that of an Italian priest, Father Figari, who invented a triple cannon that cost 300 pounds.

Machine guns seem to have fallen into disuse during the early part of the eighteenth century but reappeared later in this century with many new improvements. It is but recently, however, that the true automatic gun appeared; the arm in which the gas generated by firing supplies the necessary impulsion for functioning the mechanism.

The early use of machine guns by cavalry is indicated by Vasselien, who in writing of the march of an army in the fourteenth century states: "immediately in rear of the vanguard were two squadrons of light cavalry with four *organs* each drawn by four horses."

In the armies of to-day machine guns are regarded as an adjunct to facilitate the action of cavalry, being a necessary addition to its fire power.

Machine guns are weapons of opportunity. They deliver compact sheaves of fire with great rapidity and precision. In addition to their annihilating effect upon an exposed enemy their use has a great moral effect upon both sides. The monotonous rattle of their discharge brings confidence to their own troops and terror to the enemy. With reference to their use in the Russo-Japanese war, the Russians, demoralized by continuous retreats, "saw machine guns everywhere" and, according to Soloviev, called them "inventions of the devil"; while a Japanese officer declares: "To-day, even at maneuvers, my heart palpitates when I hear the rattle of machine guns."

(Here follows a brief description of the guns used in the armies of Germany, France, Switzerland, England, Denmark, Austria-Hungary, Italy, Japan, Russia, Sweden, Norway, Bulgaria, Holland, Turkey, China, Belgium, Chile, Mexico, Argentina, and Spain. The organization of the machine gun units assigned to the cavalry of the more important armies is also given.)

—Matériel

United States

See also
BROWNING MACHINE GUN

—Tactics

See also
TACTICS—INSTRUCTION AND TRAINING

[The Tactics of the Machine Gun. *Jour. U. S. Cav. Assn.*, Jan, '18. 15,000 words.]

Machine gun fire is concentrated infantry fire. It can be concentrated on a single oval area, or by traversing the gun it can bring sweeping fire to bear over a wide front. Thus the machine gun gives to a small group of men the power of either keeping up a slow, deliberate fire or delivering sudden gusts of fire, turning it rapidly on a diversity of targets or directing it upon one narrow space of ground, or again sweeping the front with a rain of bullets, called by the French a "mowing down" fire.

The fact that only a few men are engaged in operating a group of guns, and that each gun is fired from a fixed support with mechanical control of elevation and direction, allows less scope for the errors introduced into infantry fire by the human elements. A body of infantry firing the same number of bullets will introduce many errors due to excitement, the taking of a new aim each time, and the proximity of the enemy. The machine gun, because it is a machine, and because it is aimed by one man, delivers an ideally controlled fire.

The machine gun has at least the power of fifty rifles, probably more nearly one hundred. It requires only a front of a few yards while a hundred rifles in the firing line in the first stages of an attack may cover nearly an eighth of a mile. It is easier, therefore, to conceal it from view and to secure for it effective cover against fire. As it fires from a fixed support it not only keeps its target and range better than the best riflemen, but it has a longer effective range. All of these qualities tend to make the machine gun invaluable for delivering a sharp blow. Its gust of destructive fire has a peculiarly nerve-shaking quality and the effect is all the more demoralizing when the gun is concealed.

For indirect fire the machine gun is far superior to infantry. If the distance and direction to the unseen target are known, and it is within reach of even the longest range of the gun, the target can certainly be hit if the trajectory clears the intervening obstacles. It is not a matter of chance but of certainty, and the bullets will fall upon the same patch of beaten ground as long as the gun is kept in action.

In the early days of machine guns it was objected that the gun would consume ammunition at a tremendous and even prohibitive rate, and would be liable to be put out of action by the mere want of cartridges. Experience shows that a machine gun properly handled is at work in most cases only a few minutes at a time. Fire is used when it will tell heavily. The winning of battles now depends to a great extent on the ammunition supply being previously arranged in a methodical manner with a definite view to the intended operations. This is eminently true of the machine gun arm.

Another drawback has been the liability to unex-

MACHINE GUN—Continued

pected stoppage. For this reason the machine guns always work in couples. Two guns form the smallest tactical unit, and we have seen that two guns represent a very considerable fire power.

The drawbacks enumerated are, therefore, met by a carefully organized ammunition supply and the working of guns in sections of two each. Machine guns are out of action while on the move, altho in well trained hands they can come into action instantly. Therefore, once the guns are in a good fire position they should not be moved without reason, the movements should be as rapid as possible, and the new position should be selected before the guns are moved.

The machine gun has no place in a fight at close quarters. Therefore, during the attack it keeps in action as long as its fire can be maintained without danger to the assaulting troops. When the fire has to cease the guns are got ready to push forward and assist in holding the captured position against a counter attack. On the defensive, the guns are kept in action till the last moment, but during the actual struggle for the position, and when the attacking force is penetrating into it, the machine guns should be withdrawn and held ready, either to cover the retirement or to be pushed forward to reopen fire on the retiring enemy, if the assault is repulsed.

The machine gun may often be sacrificed to cover a retirement. The weapon is so easily manufactured, and should be available in such large numbers, that the loss of a few guns is not a serious matter. It is much more difficult to replace the trained officers and gunners of a section than the guns themselves.

A practical working system of machine gun tactics must be based upon the effect to make the most of the characteristic powers of the weapon. If it is to be used effectively, it must be in the hands of officers and men thoroly familiar with their guns and imbued with the enterprising spirit that will seize and make the most of every occasion for their intervention in the fight.

The machine gun can range up to 2800 yards, and in properly trained hands can do good work at this extremely long range. The height of the trajectory at long range favors indirect and overhead fire by making it a simple matter to clear intervening obstacles and to fire safely over the heads of one's own advanced troops. Experience of the machine gun work in the entrenchment battles of the western front shows that there are plenty of means of using the guns at even the longest range.

In most of our training camps it is laid down as a general rule that the effective ranges of the machine guns lie between 1000 and 500 yards. This refers to machine guns acting with infantry and pushing forward with them in the advance. The use of the guns at longer ranges is for covering fire over the heads of the infantry they are supporting, or directed against the enemy's supports and the lines by which he is bringing up his reinforcements.

There are now two kinds of machine gun tactics: the tactics of long range, rendered possible by the conditions of the entrenchment battle, and the tactics of medium and short ranges, which have their place in the maneuver battle in the open, and the assault during the entrenchment battle.

Long range fire is rendered practicable and effective in the entrenchment battle by the fact that the enemy's position is fixed and easily defined. Systematic aerial reconnaissance renders it possible to map out most accurately the position of the advanced trenches which form the enemy's firing line, the trenches farther back, where he keeps his supports and reserves, and the lines by which these supports and all supplies of ammunition must be brought up to the advanced trench. Reconnaissance of the enemy's position can reveal the areas where it is vulnerable to machine gun fire, and this fire can be directed on these areas with certainty. Thus the fire from the guns will harass the enemy, impede his movements, and inflict loss upon him.

It is obvious that the longer the range the more chance there is of selecting lines of trench that are open to enfilade. The machine gunner can pick out lines of trench far away to the right or left, on which he can bring diagonal indirect fire. The beaten zone is so moderate in extent that several guns have to be used together to sweep a given extent of ground either in frontage or depth, tho the single section of two or four guns is sufficient when firing on a narrow target, such as a communication trench.

In the entrenchment battle, the position for the guns at the outset will have been deliberately chosen beforehand, as well as points in the advanced line to which guns will be brought under cover by the communication trenches. There will be abundant ammunition, the choice of targets will be easy and the ranges can be fixed with absolute accuracy. They may also help in the destruction of the wire entanglements by cutting down the supporting posts.

Once the assault is launched, the guns in the advance trench push forward after the first wave, their most important work being to organize for the defense of the captured ground. A captured line will usually have an irregular front, some portions lying well to the front of the main line, and these advanced points will afford good positions for bringing the enfilade fire of machine guns to bear on the counter attack.

In the defence, with a comparatively small number of machine guns installed in carefully concealed and thoroly well protected positions, provision can be made for sweeping with flanking fire long fronts of the advanced trenches, and at the same time guns can be used from positions farther back to bring a high angle fire to bear upon the supports of a hostile attack. The mobility of machine gun sections provides ready means of reinforcing any point of the front that is attacked.

In maneuver warfare the most important work for the machine gun will be to support the infantry attack. Besides the long range covering fire, it will be well to have machine gun companies accompanying the infantry in the attack, in order to increase their fire power and give them the advantage of suddenly concentrating an intensely powerful fire upon a given area in the hostile line when the opportunity offers. Now that machine guns are being multiplied in numbers in all armies, there will usually be a sufficient number so

that some can be held with the reserve. This reserve of machine guns does not represent fire power left idle but it should be classed with the infantry supports and reserves kept in hand to be used to reinforce and carry forward the firing line.

In case of the temporary or complete failure of the attack, the machine guns will have to do their utmost to cover the reorganization or retirement of the infantry they are supporting. Some guns will be used to create a screen of fire between the infantry and the enemy; others will use high angle fire against the reserves which the enemy is bringing up for the counter attack. In a prolonged retirement a rear guard should be well provided with machine guns. The best plan is to divide the machine gun force into two portions, one of which will be in action while the other is taking up a second position farther to the rear.

In the case of cavalry against cavalry, the action of machine guns will be analogous to that of horse artillery. They will endeavor to take up a flank position, from which they can bring their fire to bear upon the enemy's cavalry while their own cavalry is advancing to the attack. The guns will have to provide for their own protection, and will often be able to take up a position where they are practically safe from mounted attacks.

Armored cars have provided a new field for machine guns. As a rule the heavier type of car, in which the gun is permanently mounted in a kind of turret, will operate on the roads. It can give invaluable support to patrols and detached parties, the men working the gun being themselves fairly safe from rifle and machine gun fire. The drawback of the car is that it is rather a prominent target for artillery. In another type the gun is merely carried up by the car and is then taken out and placed in position.

Motor machine guns have been successfully used to close a gap in a line or support troops who are rapidly driven in. In covering a retreat along a good road they would be invaluable. Their normal work, however, is to support patrols and advanced parties, to operate against enemy patrols, and to form an efficient mobile reserve. The heavy motor car has the advantage that, besides carrying the gun, it can convey a large supply of ammunition, and is thus an independent unit.

Machine guns have been used successfully against airplanes during the present war. Their widest use has been, however, by the airplanes themselves. It is evident that the machine gun, which absorbs its recoil in actuating its mechanism, is the ideal weapon for this purpose. Rifles have been used but the machine gun is far superior. The rapidity of its fire increases the chances of a really successful hit, and the gunner has a better chance of damaging a hostile airplane than if he were firing from the ground. He can hope to obtain a position from which he can bring his fire to bear on the vulnerable points in a direction from which more than one of them will be within his possible line of fire, and he can close to an easy range.

Machine guns are said to be mounted on some of the German aircraft on a platform on the top of the body of the ship, with a view to supplying fire effect against hostile airplanes.

[On Machine Guns in the Present War. *Kungl. Krigsvetenskaps-Akademiens Tidskrift,* Apr, '18. 3200 words.]

This article treats the subject from two points of view: The machine gun in position warfare and in open warfare.

Position Warfare.—Defense of fortified positions. The command having come to the conclusion that a great number of machine guns would be necessary and having made provision for this emergency, the machine guns, more or less numerous, seem to have been placed in the first firing line flanking the obstacle-lines in case of attacks. They were protected by infantry which, as well as the machine guns and the service crews, would seek cover in dugouts under the first firing line in case of enemy artillery attacks.

It proved that, owing to improved artillery methods, the losses were too great. The machine guns were then placed in or near the reserve lines from which the heavy machine guns especially were perfctly able to cover the positions desired.

These heavy machine guns will in most cases be placed in strong, well-marked concrete shelters from which positions they would be able to prevent enemy advances on the main firing line, or, in case of the latter having been taken, would be used against the positions in the rear as well as supporting counter attacks.

However, the demand for a greater number of machine guns and for increased mobility of the heavy ones brought the introduction of light machine guns in great numbers into almost all the armies. They are used in the first line or are more advanced than the heavy ones. Thru slight changes in the construction of the heavy machine gun, the mobility and the efficiency have been greatly increased.

For us, with our limited amount of machine guns, it is of the greatest importance to conceal their positions in the field, so as to attract the least possible attention of the enemy. Suitable positions would be back of hills, in woods, in which case openings would be cut out, or behind houses (ruins of houses), etc. If machine guns are placed in the first line, nothing, not even a heap of earth, may betray their whereabouts. Alternative positions should be chosen and made ready beforehand.

The machine guns might be advanced during the night to the first line. As regards the distribution of the machine guns on the front, it may be said that the positions on the continent are literally sown with them. As a rule several machine guns, both light and heavy, are to be found right behind the front of each company. They are usually placed singly, which, on account of their great number, cannot be detrimental, as one might substitute for the other in case of destruction or faults in the mechanism.

We could not follow this example, however, owing to our small number of machine guns. It would be better for us to place the machine guns by twos with a larger front to cover. This would not necessarily mean that the two pieces would have to be placed side by side, but that they would co-operate in solving the same problem.

MACHINE GUNS—Continued

The length of the front exercises great influence on the number of machine guns as well as the number of men. We hear quite often that some companies hold fronts a kilometer or more long. These companies must be supported by a very great number of machine guns, if the ground is not exceptionally good for defense. The number of the machine guns at our disposal will decide their use, as well as, to a certain extent, the grouping of the infantry for defense. How big a front should be given to a detachment with two guns cannot be stated, because it depends on too many factors. It is, however, easier for a detachment to answer for a certain front, if the fire does not have to be distributed to two sides, but may be given in the same direction by both pieces.

In general, it seems most advantageous to give a detachment a limited problem which might be solved with comparative security.

The question of command between machine gun detachments and infantry seems to be arranged thus: The light machine guns are under the commander of the infantry where the machine guns are placed. The heavy machine guns execute the orders of the commander of the detachment, who in his turn receives his orders from the commander of the machine gun company, who again is under the orders of the chief of the battalion. Of course, this does not exclude the possibility of the infantry commanders asking for assistance from the machine gun detachments.

Disposing of so few machine guns as we do, our detachments would hardly be put under the orders of anybody but the chief of the battalion—sometimes under the chief of the regiment. A machine gun detachment might under some circumstances be placed on the front of another battalion than the one which they are going to defend. The fewer the machine guns, the more important it is to have secure telephone communication with the various groups of troops which they are under orders (or are able) to assist.

The opinions as to the use of the machine guns in attacks seem to agree, on the whole. The heavy machine guns ought to be placed on high ground or have flanking positions and, when the attack begins, thru their fire keep the enemy down in their lines and also isolate the object of the attack from the neighboring positions.

The attacking infantry might, however, soon get into the fire of their own machine guns, which makes it imperative that the storming lines should be accompanied by machine guns to be placed in the occupied position to facilitate a continued attack and to prevent enemy flanking attacks; also to destroy the enemy flanking machine gun fire thru directing the fire on the fire openings of the machine gun nests.

Great care must be taken that there is a sufficient supply of ammunition, as the accompanying machine guns are often isolated from succor by the enemy barrage. Besides these two groups of machine guns, reserve ones ought to be prepared to accompany reserve troops to consolidate conquered positions.

The light machine guns are the best for accompanying storming troops; the German troops have, however, shown that the heavy ones may be employed, even if with difficulty. Our own machine gun is fully able to accompany an attack.

The manner of firing in position warfare depends on the number of pieces employed, and due consideration must be given to the inferior aim and range of the light machine gun as compared to the heavy one.

If a great number of machine guns are to cover a certain front (depth), a smaller part is allotted to each one; it would be very unsuitable to let all, or even part of them, cover the whole front.

With few machine guns to cover comparatively big fronts and big depths, the firing methods must, of course, be more intricate. The machine gun operators, especially ours, must acquire ability not only in simple (direct) firing methods, but in plane, height and depth firing.

The slanting position of legs of the machine guns does not seem to be very suitable in position warfare as regards the latter two methods of firing.

Decided importance is given to constant control of aim-finding and the trajectory of the bullets. The fire is given in short bursts for this purpose. A cool behavior of the observation posts is imperative. With the short distances of the position warfare the impact may almost always be observed.

Open Warfare.—There has not been the same amount of experience in open warfare as in position warfare. The opinions sustained before the world war seem to be right as regards open warfare.

The question of using machine guns at long or short range has been much discussed. Five hundred meters seems to be the maximum range for light machine guns; they cannot be used to fire over the heads of their own troops. The heavy ones have on many occasions, in attack as well as defense, fired at a distance of 1500 m. and more with excellent effect. During attacks this effect has been, to be sure, only moral, but has also made the enemy infantry fire too high, which facilitated the advance of the attacking infantry. Long range firing implies increased use of ammunition and consequently well arranged means of supply.

The positions chosen by the heavy machine guns must be such, and they must be so operated that they will not be discovered by the enemy artillery fire. This includes the masking of smoke and steam from the guns. We are apt to overlook these things on account of our drilling without ammunition.

Measuring the range ought to be done conscientiously and coolly by well-trained men; a bad range-finder is worse than none at all.

What has been considered a minimum for machine guns in the world war ought to be our aim for building up our machine gun arm at the present time.

One of the most valuable war machines is the machine gun. Like all machines, it has the defects of its qualities and its effect depends upon the skill with which it is handled or the ability of the operators to place the gun in a position favorable for its action and to operate it. This position should include a suitable field of fire and, above all, concealment from the enemy; for machine guns, discovered, are easily de-

stroyed. Once out of action they leave dangerous gaps in the line. The ability mechanically to operate the gun goes hand in hand with the ability to *place it tactically* and it is thought our machine gun service would be much improved if more attention were paid to training the gunners for tactical co-operation with the other arms and less to the technical side.

—Troops

[Scientific Determination of the Aptitudes of Machine Gun Personnel. By J. Boyer (**Ibérica**). **Reprint** in *Memorial de Caballeria*, Oct, '17. 1300 words.]

M. Lahy, a French scientist, has occupied himself in studying traits of the machine gunners, employing in this study psycho-physiological methods analogous to those used in civil life in characterizing professional aptitudes of employees. M. Lahy, thru questioning the officers of his brigade, classified the machine gun personnel in groups of good and bad. He then separated the men into groups of gunners and loaders and proceeded with a series of methodical experiments for the purpose of discovering the qualifications that indicate general aptitude.

The soldiers selected were men who had been at the front for 18 months in the most dangerous posts. The gunners were required to fire at the normal velocity of 500 shots per minute at targets placed at different ranges. The loaders were required to feed a machine gun (Model Saint Etienne) at a rapid rate until a special mechanism, the action of which was governed by the movement of the loader, stopped the gun from functioning.

The results obtained may be summarized as follows: In good machine gun men the visual and auditory reactions are of extraordinary brevity. An electrical chronoscope was used to measure the time of *auditory reaction*, and various electrical devices to determine the time of *visual reaction.*

It was shown clearly that good machine gun men are characterized by times of reaction which are very rapid and of but slight variation.

The investigator next determined the rapidity with which his subjects repeated the same movement, this with reference to their value as loaders.

By means of the pneumograph and other instruments he then studied the variations in the respiration and pulse of gunners while aiming and firing. The graphs thus obtained afford an excellent means of classification. Good gunners were shown to be able to adapt, or accommodate, their organisms spontaneously to the operation of the piece. Poor gunners are shown by the graphs to respire in a disordered or uneven manner; it may be said that they lack *functional plasticity.*

The results of the scientific experiments made are in complete accord with the observations of actual battle.

—Troops—Cavalry

[Cavalry Machine Gun Troops. Ramos. *Mem. de Caballería*, Sept. '18. 1180 wordd.]

A proposed organization of machine gun troops (Escuadrones) in Spanish Service. Personnel, one captain, four lieutenants, six sergeants, nine corporals, four privates first class, one trumpeter, two horseshoers, one blacksmith, and forty-seven privates per section. Duties, one lieutenant on rangefinder, leaving captain free to conrol action. One private acts as armorer and one as saddler in each section. Others as gunners, drivers, and "carters" (carreros). This implies that guns are mounted on carts.

Author asks for three sections of three or at least two guns each. Contemplates continuous fire of one gun in each section.

Mention is made of machine gun now before the "Comisión de Experiencias," designed by the armorer, Fourth Section, Escuela de Tiro, said to be ideal from a cavalry viewpoint.

It is also noted that the entry of the United States in the present war has closed the last market for machine guns, and Spanish manufacture is suggested.

—Troops—Organization

Switzerland

[Wagon Machine Gun Companies and Their Importance in the Division. By Col. Immenhauser. *Revue Militaire Suisse*, Mar, '18. 5400 words.]

I. Organization and Mobility

There is in the Swiss Army one company of machine guns per brigade of infantry in which the guns are carried by wheeled vehicles, and one pack company per mountain brigade. These units are attached to the division; the officers, sergeants-major, sergeants, and corporal-drivers are mounted. The four-horse wagons are driven from the saddle, unlike the case in the machine gun companies belonging to the battalion, where part of the drivers walk and the others drive from the seat. As the radius of action of these two or three companies covers the whole field of two or three brigades, they must be exceedingly mobile, much more so than those belonging to the battalion. At present there are six guns in the wagon-company with 73 horses, too many for the number of guns. The rear box of the caisson of the present organization could hold two machine guns with shield support, reducing the cartridges carried from 9600 to 8000 only. The new company would then have, outside of the six wagons each carrying one machine gun with tripod and 8000 cartridges for distant combat, six caissons each carrying two guns with shield support and 8000 cartridges for short range work. Thus the company would have in all six pieces with tripod and twelve with shield support. Thus five sections could be formed, two for distant firing of three pieces each and three for close work of four pieces each. The present personnel would suffice, four subalterns and one qualified sergeant for the section chiefs. Of the 50 remaining enlisted men, 36 would operate as gunners and assistant-observers, the remaining 14 as ammunition carriers and reserves.

Wagon companies justify themselves only if their mobility enables them to be employed when ordinary machine gun companies could not be used. As a matter of fact, their superior speed is shown only in the march on a road, alternating in the walk and trot. In

MACHINE GUN—Continued

this regard the best system is that used by Col. Bluntschli of the Bavarian Artillery. He places his sections on the road at distances equal to the length of the sections. When the gait is changed it is not changed in the whole column at the same *time* but at the same *place*. This scheme alleviates the dust and allows trotting on short spaces not usually utilized. (This system is probably more useful in Switzerland than in a level country.)

II. Value of these Horse Machine Gun Companies to the Division

In an advance, these mobile machine guns would be invaluable to an advance guard. All cavalrymen should know how to change the belt, as the nearest man may frequently be called on to fill the place left by a casualty, and more often than not in advance and rear guard actions a cavalryman would be the one who happened to be near. In rear guards, the very mobile machine guns alone would be equally indispensible to aid the cavalry. In fact automobiles, if there is no snow, are able to hold a crest and then get away if the descent is zigzag. In actual war, with the front extending from the sea to the frontier or from frontier to frontier, the strength of the army is not enough to have the whole line made up of adjoining divisions or brigades. As a consequence there are intervals which must be filled with troops whose mobility makes up for their lack of numbers. Cavalry brigades, wagon machine gun companies, infantry in automobiles, and cyclists must fill the gap.

III. Examples of the Use of Wagon Machine Gun Companies Before the Front and In An Advance

(Problems follow based on Swiss maps.)

IV. Choice of Men and Officers

In the choice of mounted machine gun soldiers, one must pick those who volunteer for this branch because of natural aptitude, and even among them there must be a weeding out. For a detachment of mounted machine gun soldiers the very best are none too good. Their independence and responsibility are so great that only the coolest, most perfectly disciplined and instructed soldiers have the ability to handle their tasks. Also the value of their arm is from 40 to 60 times that of a rifle. In wagon machine gun companies alone have officers of an infantry corps occasion to develop knowledge of the use and care of horses. The mounted service, in horse or wagon sections, should be given as a reward for good service as officers in dismounted organizations and for interest in the horse.

MAGAZINES

See

ARSENALS

MALINGERING

[Malingering in U. S. Troops, Home Forces, 1917. Compiled by Maj. Pearce Bailey, M.R.C. *Military Surgeon,* Mar and Apr, '18. 17,500 words. Illustrations.]

(A compilation made in the office of the Surgeon General, U. S. Army, from reports of medical officers thruout the army.

After discussing the frequency and general causes of malingering, the writer considers the motive of the malingerers under the headings of: (1) To evade service; (2) To avoid duty; (3) To obtain service; (4) To obtain exemption from punishment; (5) To obtain transfers.

Some three-quarters of the article is given up to a detailed discussion of the detection and management of malingering under the various symptomatic groupings.)

MANEUVERS

See also

INFANTRY—MANEUVERS
MARCHES AND MARCHING
OFFICERS—INSTRUCTION AND TRAINING OF (Article: "Japan, Regulations for Combined Maneuvers)

MAPS AND MAPPING

See also

PHOTOGRAPHY—AERONAUTICAL

—Map Reading

See also

INFANTRY—FIRE—INSTRUCTION AND TRAINING (Article: "Fire Exercises on the Map")

MARCHES AND MARCHING

See also

FEET

[March Experiences in Desert and Mountainous Regions. By Major S. *Memorial del Ejército de Chile,* Oct, '17. 3700 words.]

Various instances are cited of notable marches made across difficult regions in Chile and Peru. The march of the Division Lynch from Tambo de Mora to Curyaco is given as an example of order and good discipline. Preparatory measures were excellent. On some occasions marches of 40 kilometers were made. The column was broken up into echelons. Detachments were sent in advance to locate water holes and to arrange for the supply of water. Water was also carried with the troops. One battalion commander required his men to utilize the intestines of swine as containers for water.

Marches were made at night or during the coolest hours of the day. Rests of 20 minutes per hour were ordered. 200 kilometers of difficult country were traversed in 62 actual marching hours between the evening of the 17th and morning of the 25th. The column arrived at its destination without a single straggler.

The following measures are recommended for marches thru mountainous and desert localities in time of war:

(1) Careful preparation in advance for supplies of food, forage, water and munitions.

(2) Frequent exercises in time of peace which should include the crossing of mountains and deserts in order that the troops, and especially the officers, may learn by experience the effects of the desert climate, of thirst, of snow-storms and avalanches, of altitude sickness, and of the difficulty of conducting sup-

ply trains over desert sands and over steep and narrow trails in the mountains.

(3) Marches in the desert should be made at night or during the cool parts of the day.

(4) Columns should march in echelon formation, each echelon with its own baggage and supply train.

(5) Hourly rests of 20 minutes each should be given in the desert.

(6) Marches in the mountains should be made in daylight and rests should be frequent and short. The pace should be slow.

(7) In the desert especial care must be taken of the water supply.

(8) In the mountains special attention must be paid to the footgear and clothing of the men and to shoeing of animals.

(9) A well organized and equipped sanitary detachment should be present to care for the health of the command.

[Marches. By G. Bastien; arranged by Col. Luis F. Acevedo. *Memorial del Estado Mayor de Colombia,* Oct and Nov, '17. 4500 words.]

Rests

The number and length of rests are determined by the march commander.

Rests are for the purpose of satisfying calls of nature, repairing damaged clothing or equipment, for resting the tired men and allowing others to catch up, and to afford opportunities to eat. The secret of success in long marches is the proper distribution of the halts.

In Germany and Austria the first halt of a few minutes is made from ½ to ¾ of an hour after beginning the march. This is followed by one or more long halts depending on the distance to be covered, the temperature and the nature of the roads. In France, Russia and Italy columns of combined troops halt 10 minutes in every hour and march 50.

Our (Colombian) regulations state that if one halt is contemplated it should be made after covering more than half the total distance, if more than one they should be made at 2 hour intervals. Halts should be made during the warmest part of the day and troops should be notified how long the halt will last.

In the case of long columns, say a division, the leading brigade should halt and get off the road allowing the rear brigade to pass. These halt and fall out as soon as uncovered, and take up their regular positions when the march is resumed.

Long halts should be made in places protected from the sun, wind and the rain; they should be made near plenty of good water and near trees.

If the command is composed of a division or over several camp sites will usually be chosen for long halts. The march commander should know just where the leading elements of each unit are, at any time. March charts are used for this purpose.

If a halt is for longer than one hour meals can be prepared and served. From time to time a day's rest should be allowed the troops, one day's rest to four marching is about the right proportion.

Position of the Commander During the March

In a moving column the commander's post should be such that (1) In case of an encounter he can gallop up and make a personal reconnaissance of the probable battlefield. (2) To prevent an engagement which may be brought on by a subordinate's initiative but which is entirely contrary to the commander's plans. (3) So that he can transmit and receive orders quickly and easily. Mounted orderlies are chiefly used for this purpose. Everybody should know where the commander can be found. In a march toward the enemy he will be near the advance guard, in a retreat near the rear guard, in a flank march with the main body or with the flank guard. If he leaves his post he should leave a liaison agent there to forward messages.

Preparation for Marches

On the march, officers should always be oriented, should know where the stops will be, the nature of the country, location of parallel roads, and of lateral connecting ways between parallel columns. These things should be found out ahead of time. Roads should be cleared of all obstacles that will hinder the march.

Rationing on the March

Food for meals during a march should be prepared ahead of time as cooking on the march is a difficult matter. The tendency of soldiers is to go to sleep as soon as they halt. Officers should be careful to see that every man has a meal, and eats it before he lies down to rest.

Special Marches

These include night marches, forced marches and marches in the face of the enemy. It must be kept in mind that practice marches give a very imperfect idea of the movements that will be required during war; they are a form of training to prepare troops for the strain of marching under the most unfavorable conditions.

Fast Marches

These should be avoided. They will only be undertaken when it is necessary to place troops in a nearby position (not over a few kilometers) in the shortest possible time. The fast march pace is the double time or run. A big percentage of men will be left on the road, but some will arrive. Only the strongest men should make a fast march, and they should be stripped to the lightest weight. The rest of the troops will follow at the usual gait, bringing the equipment belonging to the fast marchers.

The capital importance of marching, and the aptitude of troops for marching as an element of success, have been proved in every campaign.

Each officer should make it a point of honor that every man under him is able to march. When on the march he should be constantly looking to his men and seeing that they do not waste their strength.

Various armies have looked for particular means of maintaining the soldiers' resistance and increasing their marching speed.

In Germany resistance rations with a high per-

MARCHES AND MARCHING—Contin

centage of sugar have been tried out. The theory of these resistance rations is that every vital energy (movement, sensation, etc.) is the direct product of chemical energy and that sugar is the most powerful producer of chemical energy of all the staples.

As a result of tests held by an infantry regiment of the Metz garrison in 1897, the chief surgeon, Leitenstorfer, reported as follows: "Sugar taken in lump form with the morning coffee constitutes a power ration which has both a dynamic and stimulating effect. It is of invaluable service in forced marches."

In Colombia we have the "panela" (a special form of sugar which is used almost universally.

Experiments in the use of Kola as a resistance ration were carried out in France by regiments of Chasseurs and colonial troops in 1887.

Kola derives most of its properties from Caffein, which is present in about 3:100 proportion. It produced an increased rate of march such that one kilometer was marched in 9 minutes 5 seconds. On the other hand it produced such digestive and nervous troubles in some of the men that its use had to be abandoned. Some of the doctors blamed these ill effects to improper administration of the kola.

Coffee, which has a percentage of caffein, is used in our army. Amongst its other properties it does lessen the sensations of fatigue.

Forced Marches

Forced marches mean increased marching efforts; the limit is the endurance of the men.

They are necessary for troop concentrations on the eve of a battle; to give the pursuit its maximum ardor after a victory; and to relieve enemy pressure at a particular point in case of defeat.

An increase in the ground covered is what a forced march aims at. It may be done by increasing the pace, eliminating the rests, or by increasing the marching hours thru the night.

Such a prolonged tension on the human body requires certain precautions to be taken, of which the principal are: multiplication of the number of columns when roads are available, increase the depth of columns, increase distance between units (with due regard to the tactical situation), eliminate the sick as quickly as possible, lighten the packs, prepare meals ahead of time so they will be ready to eat when halts are made, cut down guard and other duties to the minimum, watch the discipline carefully, and divide the marching time by few but long halts, and sleeps.

No fixed rule for forced marches can be given, but in general they should be divided into two parts, the first (longest) is marched at the regular rate, the second is marched at the increased rate with alternate halts and rests which increase in number with the distance covered.

A forced march should not last over 36 hours. Forced marches show up an officer's moral control of his men. (The author cites prolonged forced marches in the Napoleonic wars and the war of 1870 to prove this statement.)

The record march of the Colombian army was that made by the Numancia battalion, composed of Colombians and Venezuelans, which, being pursued by the Royal Cavalry, marched 110 kilometers in 24 hours without eating, drinking, or resting, and without losing a man.

Night Marches

These have become highly important since the Russo-Japanese war. They may be necessary in the following cases:

1. In concentrations before battle.
2. To effect a turning or enveloping movement.
3. To escape pressure from a victorious enemy, or to get out of an unfavorable position.
4. To effect a pursuit.
5. To move troops in front of positions or defensive works which are to be assaulted early in the morning.
6. When small forces engage a stronger enemy and must rely upon surprise for success.
7. Finally night marches are necessary in tropical countries to diminish the fatigue caused by the heat of the sun.

[Marches. By G. Bastien. *Memorial del Estado Mayor de Colombia,* Dec, '17. 2000 words.]

Marches in Cold and Hot Weather

Heat is the greatest enemy of marching troops. In order to protect troops against heat exhaustion columns should be broken up into small units with large intervals between; packs should be made as light as possible, the pace should be slackened, the rests increased, and no marching should be done between 9 a. m. and 4 p. m.

The following suggestions have been added: Place the short men at the head of the column so they will get more air. Keep the men from lying down during the halts because the ground is hot, and upon lying down the blood rushes to one's head.

March in the shade when possible but do not keep constantly changing from one side of the road to the other to do this.

In marches during cold weather the rifle should be slung so that the hands can be moved freely. The face and ears should be protected, men should not be allowed to remain still at the halts, and additional warming rations should be supplied. Cold weather never prevents marching but it may hinder it.

Incidents of the March

There are many troublesome incidents which worry troops on the march which are not necessarily caused by the enemy. The two principal ones are the passing of obstacles and the crossing of columns.

An example of these incidents happened in the war of 1870, on Aug 18, when the 2nd Army started north. The 12th Army Corps marched on Jarny and the Guard Corps on Puxieux. The two routes crossed near Mars-la-Tour, where the Guard Corps was detained on account of innumerable small fences that had to be crossed, and this blocked the road of the 12th Corps.

These incidents may be avoided by proper reconnaissance of the routes to be marched over, and by assuming formations which are not deep.

There are, of course, many bothersome incidents on the march in the presence of the enemy, and caused directly by him. These are, for the most part, unforeseen changes in the direction of march.

—Hygiene of

See also

FEET—CARE OF THE

MARNE, Battle of the

[The Battle of the Marne. By Herman Stegemann. *La Guerra y su Preparación,* Sept, '17. 15,000 words. 2 maps.]

(A complete and detailed account of the battle with special attention paid to the German action, and evidently written from the German side.

The author begins with a statement of the general situation of both sides, and a discussion of this. He then takes up the strategical situation on Sept 5, which is followed by a detailed description of the battles in the Arch of the Marne River. Following this are technical discussions of the battles of the Ourcq River, of Claro and Rebais, Montmirail-Sézanne, Vitry and Semaize and of the battles between Revigny and Verdun, and the German retreat to the Aisne. The work is quite complete, tho itself an extract. The author shows a very accurate knowledge of the positions and movements of German and Allied armies, army corps and divisions.

The article is summed up by a general discussion of the retreat to the Aisne, taking each German field army, from the 1st to the 7th inclusive, with the troops that opposed each field army, and describing its situation and movements during the period Sept 5-8, 1914.

The author closes with a critique of the grand strategy in which the various German commanding generals and their staffs are very fairly discussed.)

[Review of Hermann Stegemann's "Geschichte des Krieges." *Schweiz. Monatschrift aller Waffen,* Nov, '17. 1700 words.]

The first volume of a work by Hermann Stegemann, entitled "Geschichte des Krieges," has been published. The writer claims to have written from an impartial standpoint, as citizen of a neutral state, and to have consulted all the official reports of the belligerent powers. His comments on the battle of the Marne are of especial interest, as the reader learns with astonishment that this battle was in reality won by the Germans.

According to Stegemann the situation on the west front, Sept 9, 1914, was as follows: The first army (von Kluck) had on Sept 7 thrown itself against the French 6th Army (Maunoury) which was moving from Paris toward the Ourcq, while the left wing of the army was engaged with the French 5th Army south of the Marne. Kluck defeated Maunoury's enveloping movement, and considered himself strong enough to move forward. At the same time the German 2nd Army between Sézanne and La Fère-Champenoise was victoriously engaged with the French 9th Army (Foch). The 3rd Army (von Hausen) was south of the Maurienne sector and threatened Foch's right flank. The German movement in the direction of Arcis-sur-Aube and Troyes threatened to drive the French 9th and 5th armies back on Paris, while the armies of de Langle and Sarrail to the east were held fast on the Ornain and the Meuse, and could only retreat to the south and southeast. The 4th Army (Albrecht of Wurtemberg) had thrown the enemy across the line Vitry le Francois-Heiltz-Semaize, and the center and left had crossed the Rhine-Marne Canal. The French 4th army was everywhere in retreat. Foch's withdrawal toward Salon had left de Langle's left flank in the air. The 5th Army (Crown Prince Wilhelm) had crossed the line Revigny-Vaubecourt-Fleury-Dombasle-en-Argonne and was attacking Sarrail's army. This was the situation when the Germany army received the order to retreat. If Stegemann's statement of the situation is correct, it is difficult to justify this step taken by the German Army Command. According to the writer the order had been determined upon on the 7th or 8th, when Maunoury's enveloping movement threatened to be successful and when the 5th Army on the left flank seemed in danger of being turned. Either Stegemann's statement does not accord with the facts, or else the German Command caused the execution of an order the reason for which no longer existed. Stegemann's explanation of the latter hypothesis is unconvincing. One reason assigned by him is that the situation on the east front had confused the German Army Command, but this seems unreasonable because ten days before the battle of the Marne Hindenburg had annihilated the Russians at Tannenberg, and because from the 6th to the 10th of September successes were being won in the Masurian Lake region. The writer further assigns as reasons for this order the fact that the extreme German right was in the air, that Antwerp had not fallen, that the Belgian army had undertaken a strong attack, that the supply of provisions and reserves was precarious, that railway communications were still broken, and that danger threatened from England. It is doubtful whether these reasons were really sufficient to cause the Germans to withdraw from a battle already won, to leave the field to the beaten foe, and to present to the eyes of the world the appearance of defeat.

MASURIAN LAKES, Battle of the

[The Winter Battle in the Masurian Lakes. By Hans Nieman. Reprint from *Memorial Ejército de Chile. Revista Militar* (Argentina), Sept, '17. 4500 words. 7 sketches.]

At the beginning of February, 1915, 220,000 Russians, extended over a front of 165 km., were engaged in trench warfare with 100,000 Germans who under von Buelow were defending East Prussia.

The Russian position extended from north to south. The right wing rested on the Memel to the east of Tilsit, the left rested on the Narew to the east of mouth of the Pisseck.

The German front followed the course of the Inster and the Angerapp to Lake Mauer. To the south the defiles between the lakes were held by strong detachments. Still farther to the south there were troops in observation in the forest of Johannesberg.

MASURIAN LAKES, Etc.—Continued

The great length of the Russian position favored penetration. Decisive results could only be obtained, however, by an envelopment of the flanks in combination with penetration of the front.

The plan of Hindenburg was as follows: to envelop both flanks of the Russians and to drive them back; to remain inactive in front of the Russian center, or merely to contain it while the eneveloping movements were taking place. In this way the distances to be covered by the enveloping columns would be shortened and a decision produced about the fifth day by the completion of the envelopment, this provided the Russian center remain in place. Should the Russian center fall back it was planned to attack it vigorously, at the same time changing the point of convergence of the marching wings farther to the east in order to include the withdrawing Russians in the jaws of the pincers. The German center would necessarily advance rapidly in order to avoid having wide intervals between the armies. Complete success was possible only in case of perfect co-operation between commanders of the center and both wings.

The northern. or left wing of the Germans, consisting of three army corps, was under command of von Eickhorn, who had the mission of advancing at first along the Estuary Szeszuppe and then to advance on a broad front in a general southeasterly direction against Kwalwarija, to cut the railway line Stallupönen-Kowno, and to roll up all hostile forces in his front. Gen. von Folk commanded a corps on the right, or south wing, and still farther to the south was a corps in reserve under Gen. Litzmann. These two corps were to capture the line of the Pisseck and then to advance to the northwest towards Suwalki and Augustowo.

For flank protection during the advance lateral detachments were sent, in the north towards Taurogen, in the south towards Lomska. The latter measures of security were by no means superfluous.

The decisive battle commenced on Feb. 7th and ended on Feb 14th. It resulted in a complete victory for Hindenburg. 110,000 prisoners, 300 guns, 200 machine guns and vast quantities of other war material were taken. The forest of Augustowa was the tomb of the last remains of the Tenth Russian Army. On Feb 15 not one Russian was left in German territory, and the Tenth Russian Army had ceased to exist. 250,000 Germans enveloped and destroyed 220,000 Russians despite adverse conditions of terrain and weather.

MEASLES

See also

PNEUMONIA (Article: "An Epidemic of Measles and Pneumonia in the 31st Division")

MECHANICAL TRANSPORT

See

MOTOR TRANSPORT

MEDALS

See

DECORATIONS AND REWARDS, MILITARY

MEDICAL CORPS

See

SANITARY SERVICE

MERCHANT MARINE

See

SHIPS AND SHIPPING

SHIPS AND SHIPPING (MERCHANT)

METALS

—Military Use of

See also

ZIRCONIUM

—Use of in European War

[Substititions in Electric Matériel Adopted in Germany. By "A." *Memorial de Artillería,* July, '18. 400 words.]

Copper, due to its scarcity, was the chief metal which had to be replaced. Electric cables were constructed on an iron or steel core with zinc wire strands wound around the core. Where small conductors were needed aluminum, magnesium, and elektron were used with good results. Elektron is an alloy of 10% aluminum and 90% magnesium.

Motors (alt. current) wrapped with zinc wire coils develop from 40 to 60% of the power developed by the same motor with copper wire coils.

Transformers wrapped with zinc wire are 27% less effective than those wrapped with copper wire.

METEOROLOGY

[The Law of Buys-Ballot and the Wind in Italy. By Dr. Cesare Fabris. *L'Aeronauta,* Mar, '18. 2000 words. 10 figures.]

The English meteorologist Dines has shown that it is possible to foretell, with sufficient approximation, the direction and intensity of the wind, when we know the distribution of the pressure on the region. He has also shown that an observer may nearly always determine the facts about the air-currents which are dominating the different strata, even in the absence of a knowledge of the distribution of pressure, by a simple examination of the strength and direction of the wind near the ground.

The method suggested by Dines is based upon the law of Buys-Ballot and the application of the elementary formulas for the calculation of the "gradient wind," that is to say the wind which corresponds, in direction and intensity, to the variation of pressure. The law of Buys-Ballot is: If a person stands in the northern hemisphere with his back to the wind, he will have the low barometric reading on his left hand; if the wind is strong the fall of the barometer from right to left will be rapid, if light the change in barometric pressure will be small. Applying this law and the formulas suggested by Dines, it is found that the differences between the computed and the observed winds in the upper strata of the air are very slight in England.

Unfortunately the winds in Italy seldom follow the normal variation, and are, moreover, notably different in various parts of the country. In general, in order that the winds shall follow normally the distribution of

pressure, it is necessary that the region be not exposed to cross breezes and that the topography be reasonably regular. Even in these cases, the wind will accord to the variation of barometric pressure if the "gradient," that is, the difference in pressure from one place to another is very strong. It is rare that any of the necessary conditions exist in Italy, so the rules which are applicable elsewhere can seldom be followed. In order to make any satisfactory forecast of the aerial conditions over Italy, it is necessary that the observer should have considerable practice and a thoro knowledge of the physical characteristics of the peninsula.

(The figures show some characteristic examples of the variations of aerial conditions at different elevations.)

[Thunderstorms and Squalls in Italy. By Dr. Giuseppe Crestani. *L'Aeronauta*, Mar, '18. 2500 words. Illustration. 3 tables.]

The dangers confronting the aeronaut who ventures into a thundercloud are both dynamic and electric in their nature. The former are due to the vertical currents which exist in the interior of the cloud and which are often very violent and irregular. The latter come from the heightened intensity of the electric field that accompanies the storm and from the oscillations that occur therein and react upon the aircraft. Underneath the thundercloud are found winds, always irregular in strength and direction, and sometimes very violent. These winds often take the form of a whirl and present a serious risk to the airman who ventures into them.

The periodic meteorological telegrams give the airman a general idea of atmospheric conditions, from which he may be able to form some conception as to the likelihood of storms. They can give him little help, however, in determining exactly when or where the storm will occur. Fortunately thunderstorms present certain features and usually develop thru certain phases, so that an attentive observer can ordinarily foretell them by an hour or more.

The dark aspect of the clouds is one of the most impressive manifestations of the thunderstorm to one who is standing on the ground. He who is well up in the air should give his attention especially to the following points:

1. The presence of big cumulus clouds in formation in the direction from which thunderstorms usually come in that locality; to strong shadows or to clouds whose upper face is not even but has cumuliformous protuberances constantly arising, with the eventual formation of caps.
2. The presence of cirrus clouds, especially in the level 4-5 km.
3. The diagnosis of thunderstorms is sure when there are electric manifestations about these clouds.
4. Squalls are lacking in the grandeur of cloud formations accompanying thunderstorms, so they are thus less noticeable. They also move with greater velocity. In consequence, it is necessary to exercise the utmost vigilance if they are to be avoided. The following points should be considered in looking for squalls:

(a) Always be suspicious of the air beneath a thundercloud.

(b) Two or more thunderstorms, even tho far apart and apparently independent, are apt to be connected by a band of squalls.

(c) The agitation of trees, dust rising from the ground, and the characteristic appearance of water under the action of the wind furnish indications of the approach of a squall.

The action to be taken by the aviator varies with the particular circumstances. Often it is easy to pass over the storms, which in Italy are usually below the 2 km. level, or to go around the storm of limited size. In case of a heavy and wide-spread thunderstorm it is advisable to seek safety in flight and to take the ground before the storm arrives.

MEXICO

—Army—Cavalry

See also

CAVALRY—MEXICO

MILITARY DECORATIONS AND REWARDS

See

DECORATIONS AND REWARDS, MILITARY

MILITARY EDUCATION

See

EDUCATION, MILITARY

MILITARY GYMNASTICS

See

GYMNASTICS, MILITARY

MILITARY LIBRARIES

See

LIBRARIES, MILITARY

MILITARY PRISONS

See

Prisons, Military

MILITARY ROADS

See

ROADS, MILITARY

MILITARY SCHOOLS

See

SCHOOLS, MILITARY

MILITARY SURGERY

See

SURGERY, MILITARY

"MINENWERFER"

See

FIELD ARTILLERY—MATERIEL—TRENCH MORTARS

MINES, Land

See

SAPPING AND MINING

[Ruses and Snares of the Enemy When Retreating. *Infantry Jour.*, Mar, '18. 1900 words]

MINES, LAND—Continued

The following are among the most typical examples of the snares and traps left behind by the Germans during their retreat between Artois and the Aisne:

In the Shelters.—Branches across the entrance, apparently for camouflage but connected by a wire to a primed charge in the shelter; piles of coal conceal detonators; books on tables, sandbags, shovels, etc., when moved explode mines.

In the Trenches.—Buried hand grenades are connected by telephone wire and explode when the wire is touched. New flooring of firing steps conceals a stem grenade which explodes when stepped on. Primed grenades are scattered on the ground.

Along Roads.—Fougasses concealed under an undermined road which will support the weight of men but gives way under loaded convoys.

In Wire Entanglements.—Net works of wire covered by branches.

Dwellings. — Undamaged, houses, surrounded by others that have been destroyed, often contain timed explosives. The town hall at Bapaume blew up several days after it had been occupied by British troops. Bickford fuzes set in fireplaces, detonate when fire is lighted. Mines are laid in wells. Wells are contaminated.

Stables.—Grenades hidden under floor explode under slightest pressure. Forage may be impregnated with cultures of glanders.

Poisoned Food.—German orders indicate that poisoned food is left behind.

Precautionary Measures.—Traps are to be more expected where the enemy has voluntarily retreated. Until specialists have had a chance to investigate the following they should be avoided:—well furnished shelters, undamaged houses surroundedd by ruins, recently constructed trenches, freshly turned soil, articles stuck in the ground, and refinished floors.

Stables should be thoroly disinfected, and all forage burned.

All water supplies must be prohibited until the water has been analyzed by experts. Gas may be found in wells.

Listening tests must be made in all buildings, tunnels, etc., in order to detect clock-work driven infernal machines.

Roads must be thoroly inspected to detect mine galleries or fougasses.

Some traps are fired by clock-work or by pulling on a wire. In cutting wires pains must be taken not to pull them.

According to information from prisoners it appears that the Germans have made extensive preparations for mining the trenches and shelters which they contemplate evacuating. During an advance our troops must not occupy the enemy trenches but must go beyond and build new trenches.

MINES, Naval

—Use of in European War

[U. S. Navy Co-operation in Laying the North Sea Submarine Barrage. *Official Bulletin,* Oct 30, '18. 1700 words.]

The U. S. Navy co-operated with the British in laying the immense mine-field in the North Sea designed to bar, as far as possible, the egress of U-boats to the Atlantic.

A new type of mine was invented, many thousands manufactured and sent overseas, assembling and loading bases established abroad, and mine planters and all other necessary equipment sent abroad. The loading plant had a capacity of 1000 mines a day, and twenty merchant vessels have been engaged in transporting the matériel.

Admiral Strauss commands the mine force abroad. After a thoro study of methods in use, it was concluded that mines offered the only practicable solution of the problem of closing the North Sea. A new mine was designed using an electrical device invented by Mr. Ralph Browne, an American.

To obtain the new mine in quantity and at the same time preserve secrecy, the plan was used of having different parts of the mine made at different places. These parts were then brought together and assembled. 140 principal contractors and over 400 subcontractors participated in the work of manufacture. Most of the work was done in automobile plants.

MOBILIZATION

See also

FRANCO-PRUSSIAN WAR—RAILROADS IN
GERMANY—ARMY—MOBILIZATION

—Concentration Camps

[The Rapid Construction of Camp Lee, Va. By Jorge Soriano. *Mem. de Ingenieros,* July, '18. 2000 words.]

The well known expression, "Time is golden," is not so well understood and acted upon in Spain as in the United States. In America, if it is felt that the gain in time will justify it, there is no hesitancy in doubling or even tripling the cost of construction work; whereas in Spain construction work is frequently permitted to lag in a disgraceful manner merely to effect a very slight saving. It is not desired to recommend too high a disregard of initial cost, for the question of cost must be carefully weighed against the value of speed in construction, especially in civilian practice. In military work this is not so important for nearly all military constructon work is done under high pressure for completion.

In May, 1917, the American Secretary of War decided to build 16 great cantonments, each with a capacity of 40,000 men, to be used to accommodate the contingents of the National Army during its period of instruction. These cantonments had to provide not only the shelter necessary for the troops and matériel but also the hygienic measures needed in a city of 40,000, as the troops were not accustomed to military life.

The plan adopted was the construction of wooden houses of one or two stories, covered with tar paper roofs, on account of the great abundance of these materials and the ease of transportation to the work. About 1600 buildings were planned for each camp. Each project called for the necessary sewers, streets, electric lights, water, telephones, etc., at the same time.

The camp site was selected the middle of June and completion of the work was scheduled for the first of September. 74 days for doing the work. The contractor was selected according to the experience and reputation for ability on large jobs of those who submitted bids. His pay was fixed at ten per cent of the cost, with a limit to the cost of $250,000.

High wages and extensive advertising soon brought in all the laborers in the vicinity of Camp Lee, so that during the construction of this camp the greater part of the work of Virginia and northern North Carolina was held up by lack of labor. The cost of labor was greatly increased by government regulations governing the 8 hour working day, with an increase for overtime and Sunday work. The government figured, however, that the loss from this source was small compared with the loss which would occur from delay in the construction of the camp and its occupation by the recruits.

MONTENEGRO

—History

See also
BALKAN WARS

MORALE

[Comparison and Conclusion—The Moral of Our (Swiss) Army. By V. *Revue Militaire Suisse*, Jan, '18. 6000 words.]

(Writer compares the morale of the Austrian and Swiss armies.)

The patience, equanimity, and calm gaiety of the men of the Central Empires stands out in contrast to the nervousness that characterizes the Swiss. Among the former the petty quarrels of the profession are entirely swept away by the purifying influence of danger. Our soldiers seem dull, too new, too satisfied, but the vigor and seriousness is under the surface. They salute their officers easily and with head high. The lassitude of the Swiss Service is due to:

1. Continual changes in the method of individual instruction.
2. The ignorance of the press.
3. Anti-militarist propaganda.
4. A feeling among the soldiers that they are forgotten.
5. The long wait under arms.

In spite of the experience gained in campaign and in progressive training the efficiency of the troops of the Central Powers is less than in 1914 because of:

1. Hasty instruction.
2. Mixing old and young and the incorporation of an increasing number of men of damaged physique.
3. Improvised cadres of officers.

Nevertheless the Austrian morale is very high. The *esprit de corps* is good despite frightful losses. The ties binding officer and man have assumed a character of grave and respectful familiarity. Devotion of men for officers often goes to the point of heroism. The truly democratic chief is often found, be he simple lieutenant, general, or archduke.

MORTARS

See also
See also
ARTILLERY
COAST ARTILLERY
FIELD ARTILLERY
FIELD ARTILLERY—MATERIEL—TRENCH MORTARS

[Notes on Mortar Fire Direction and Target Practice. By Col. A. W. Chase, C.A.C. *Jour. U. S. Artill.*, Sept-Dec, '17. 10,000 words. 2 tables.]

The present range corrections in mortar fire are inaccurate and unsatisfactory and are largely responsible for irregular results in target practice. A discussion of them will be of interest and may lead to beneficial changes.

There are two authorized methods for determining elevations for mortar firing, the mortar arm zone elevation scales and the Model 1914 Mortar Range Board. The zone elevation scales on the mortar arm are constructed for sea level and are valueless for high sites. The zone elevation scales of the Mortar Range Board are constructed for range table conditions and must be corrected for high-sited batteries. Both are inaccurate for any but the normal velocity for the zone considered, and as the velocity is practically never normal, the elevations are practically always in error. (Follows a calculation showing that a loss of 20 f. s. muzzle velocity results in a diminished width of 72 yards for the fifth zone, and that the present method of range corrections from trial shots will result in shooting *over* 36 yards at 65° elevation and *short* 36 yards at 45° elevation.)

The present system also gives grave errors in time of flight when applied to reduced muzzle velocities, amounting in extreme cases to as much as four seconds. "The algebraic sum of the range errors, due to the use of the normal zone elevation scale is, therefore, made up of errors due to use of normal elevations and to estimation of travel from normal times of flight instead of using a zone-elevation scale with times of flight corresponding to the *reduced* muzzle velocity." The elevation errors affect both range and drift, thus causing both deflection and range errors.

From a suggestion by Capt. J. P. Hopkins, C.A.C., Capt. O. De Carré, C.A.C., prepared the De Carré Elevation Charts, which are graphic range tables, and in it the range graduations are adjustable for changes in muzzle velocity as determined by trial shots. These charts are as accurate as the range tables themselves. (Follows a discussion showing that by the use of the De Carré Elevation Chart and a Zone to Zone Correction Chart devised and prepared by Capt. F. H. Lincoln, C.A.C., both properly corrected for height of site, the corrected ranges in the case previously assumed differed but three yards at 65° and two yards at 45° from the theoretical values. The charts will be found equally accurate in all zones and for all velocities.) Range changes due to height of site do not vary by the same law as those for changes in muzzle velocity, so range tables should always be corrected for height of site in order that the results of trial shots may be correctly applied.

MORTARS—Continued

Check calculations by the author showed that the corrected ranges at reduced velocities taken from the De Carré Chart and the corrected ranges and reduced velocities for the same problem taken from the Zone to Zone Correction Chart, ordnance percentages, all plotted closely to the range elevation curves for normal conditions, 59° elevation.

With carriages in proper adjustment and care in firing trial shots, the range change will rarely exceed 200 yards, corresponding to less than 3 per cent in muzzle velocity. Based on twenty years' experience in mortar fire, the writer concludes that the effects of wind and atmosphere are sensibly constant during practice, notwithstanding apparent changes at the surface of the earth, and subsequent firing will show the same results as the trial shots.

Deviations in Mortar Practice

A method was suggested by Capt. Philip Yost, C.A.C. and reduced by graphic methods in 1913, whereby personnel and matériel errors can be separated and each examined in detail.

Range Deviations.—Range deviations due to personnel arise from a number of causes, of which the most important are: "Errors of position finding, including errors of observation of trial shot data; errors in deducing and applying trial shot data; errors of observation of the moving target; errors in transmission of data; errors in plotting, including inherent errors of the plotting board; errors in determining elevations from plotted ranges by the present systems; error in not correcting for pit displacement; and errors in applying plotting room data at the pits."

Most of these errors are familiar to battery commanders, and need not be discussed. The correction for pit displacement is greatly facilitated by the use of a device perfected by Sergt. Millard Kurtz, 38th Co., C.A.C. (See *Jour. U. S. Artill.*, May-June 1915.)

"Range deviations due to laying are principally due to errors in laying in elevation, the variable jump due in large measure to imperfect setting of friction devices, to neglect to lay *in depression* to take out backlash, and the velocity errors due to variations in ramming. Elevation and jump are taken up fully under other subheads, and we are all familiar with the effects of bad ramming.

Longitudinal variations due to the mount and matériel and to observation of fire are complex and include:

(a) Errors due to jump, inherent to the mount.

(b) Errors in devices for giving elevation.

(c) Errors due to variations in muzzle velocity.

(d) Errors due to erosion in the gun, imperfect centering of the projectiles, and variations in the finish, form, etc., of the projectile.

(e) Errors due to the imperfections of our instruments and methods for determining the co-ordinates of the splash, referred to the point of aim, both trial and record shots."

It is believed that uniformity of velocity is not promoted by blending of powder at the batteries. Uniform mechanical blending and properly sealed charges would obviate any necessity for re-blending.

Moderate pressures incident to low velocities in mortars cause little or no erosion. Errors due to imperfect centering of projectile or variations in form and finish are beyond control.

There is great room for improvement in the method of observing the splash of both trial and record shots. Both the tug and the target should be tracked and plotted. Improper adjustment of the towing bridle, and obliquity of towing due to tide may cause large errors in the camera record. A log or beam attached to the rear of the target is suggested to make the target follow the tug accurately. The Hagood mount is a good device for instructing gunners, for which purpose it was designed, but a telescopic sight on a Hagood mount is a poor arrangement for observing lateral deviations due to vibration of the instrument.

The deflections should be measured with a B. C. Telescope, Model 1910, on a pier mount. Two observers using these instruments would vastly improve our observations for lateral deviations.

Lateral Deviations.—"Lateral deviations are due, in part, to eccentricities of the mount, but almost entirely to the following:

(a) Errors in using improper drift scale.

(b) Errors in observation of trial shot data.

(c) Errors in applying trial shot data.

(d) Errors of position finding, affecting either range or azimuth.

(e) Failure to correct for pit displacement, both for range and azimuth.

(f) Errors in laying, affecting either elevation or azimuth.

(g) Improper setting of friction devices of carriage.

(h) Failure to set the elevation ***in depression***, to eliminate backlash."

The present model carriage almost entirely eliminates "jump" if the friction device is correctly adjusted and the elevation is set *always in depression*. The Ordnance test requires excessive tightening of the friction device. The best test is the old one of setting the friction dvices so that they slip freely when the gun is at zero elevation and two men apply their strength on opposite handwheels in depression.

The base ring should be releveled if test shows any error. The carriage is good enough, however, that when properly handled, the errors introduced by its imperfections or mal-function are slight when compared with the preventable errors of system and personnel.

Laying in Elevation.—The quadrant is one of the greatest sources of range and deflection errors. Its defects are such that even placed in adjustment by an expert machinist, it will not long remain so. The suggested remedy is to use the elevation scales on the elevation racks of all the modern mortars. Once adjusted, the scale should be doweled to the rack to secure it permanently in place. An advantage of this method of setting in elevation is that it can be done while the mortar is being traversed.

Sub-Caliber Firing

Results in sub-caliber firing are vitiated by the fact that the tube rests upon the mushroom head of the breech-block, and is thus not firmly supported. The remedy is to remove the mushroom head and substitute a casting or a hard-wood block. Properly adjusted to this support, the tube will never slip, and the percentage of hits will be greatly increased.

The mortar carriage should be properly cared for as is any ordinary machine such as an explosive engine. Every feature should be gone over carefully and adjusted so that the carriage will function properly and accurately. All parts should be exercised and groomed. It should be permitted to use old motors to draw the mortars back on their springs once a week.

The powder is as perfect as can be made by present methods. The present carriage functions well and regularly, and when properly adjusted and well cared for, the mortar will shoot "like a rifle in a vise." We ought to have an automatic pneumatic rammer, and with proper fire direction, we would get close to 100 per cent in hits.

[Adjustment of Mortar Fire Based on Instrumental Observations. By Capt. C. W. Waller, C.A.C. *Jour. U. S. Artill.*, Sept-Dec, '17. 4000 words.]

It is important to decide whether adjustment of fire based upon observations is necessary or desirable, and if so to devise satisfactory methods of making such adjustment. If corrections, based upon trial shots, were correct for all directions and ranges, adjustment of fire from observation would be unnecessary and, on account of its difficulty, undesirable. Attempts have been made to derive satisfactory corrections from trial shot data, but any method based upon the firing of more than two or three trial shots at a single point is open to two serious objections—too much time is required and too much ammunition used. Furthermore, data obtained from trial shots is rendered useless by changes in atmospheric conditions, and these *do not* remain constant. Hence adjustment of fire based upon observation is desirable, and in action, necessary.

All adjustment of fire from observations must be based upon deviations, either from the target or from the set-forward point. (These observations are beset with difficulties, which are discussed by the author, who reaches the following conclusions:)

"It is believed from my own experience and my study of the experience of others, that adjustment of mortar fire is necessary; that it should be based upon deviations from the set-forward point of not less than two salvos, these deviations being obtained by instrumental observation using either a vertical or horizontal base depending upon which is available; that corrections should be made based upon the mean of the deviations of the last shot (or salvo) and the center of impact of the shots fired since the allowable deviations were exceeded; that any deviation not greater than the probable error of the mortar be regarded as allowable; and that whenever corrections appear to be necessary the firing be suspended until such corrections can be determined and applied.

The necessary spotting and correction boards can be improvised and constructed by any officer with a little ingenuity."

MOTOR BOATS

—Electrically Controlled

[The Electrically Controlled Vessel. *Canadian Military Gazette*, Nov 27, '17. 350 words.]

The Admiralty has issued the following statement regarding the electrically-controlled sea raiders which the Germans have been operating off Belgium, and several of which have been destroyed.

"The electrically-controlled motor-boats used on the Belgium coast are twin-propeller vessels, partially closed in, and travel at a high rate of speed. They carry a drum with between 30 and 50 miles of insulated single core cable, thru which the boat is controlled electrically. The forepart carries a considerable charge of high explosives, probably from 300 to 500 pounds in weight.

"The method of operation is to start the engine, after which the crew leave the boat. A seaplane, protected by a strong fighting patrol, then accompanies the vessel at a distance of from three to five miles, and signals to the shore operator of the helm. These signals need only be 'starboard,' 'port' or 'steady.' The boat is zigzagged while being steered into a ship, and the charge exploded automatically.

"The device is a very old one. A boat similarly controlled was used in H.M.S. *Vernon*, a torpedo experimental ship, as far back as 1885. The only new features in the German boat are the petrol engines and wireless signals, neither of which existed then."

MOTOR TRANSPORT

See also

Field artillery—Transport—By motor

Horses

Great Britain—Army—Organization (Article: "Impressions of a Visit, etc.")

Sanitary service—Transportation of sick and wounded—Motor ambulances

Water supply—By motor tanks

France

[Motor Trucks Deliver Meat to French Army. *Commercial Vehicle*, Feb, '18. 1100 words.]

All meat distribution in the French army is carried out by motor trucks which are either former Paris motor buses or the same type of chassis built since the war began. Each motor truck is designed to carry 1800 kilos (3968 pounds) of meat, suspended from hooks on two longitudinal racks. As the meat ration in the French army is 500 grams per man (1.1 pounds), each truck can carry 3600 rations. Theoretically one meat truck can carry daily enough meat for a regiment of infantry containing three battalions of 1000 men each, or a total of one vehicle for 3000 men. Actually, it is found that one truck will supply meat for a little over 2000 men, except when hard pressed, when they have averaged a supply for 8000 men.

Seven of these trucks are attached to a division. In addition, there is a touring car used by the officer

MOTOR TRANSPORT—Continued

in charge of the section, a motorcycle for the dispatch rider, and one service or repair truck.

Once a year, on an average, each vehicle is sent to its repair shop for a complete overhaul. This repair establishment is provided with a power driven lathe, milling machine, drill presses and tire press. The motor is taken down, also gearset and rear axle; solid tires are renewed if necessary.

Two types of meat-carrying trucks, very similar in general design, are used on the French front. One is the De Dion-Bouton omnibus chassis and the other a Schneider. Both are four-cylinder cars, have three forward speeds, the final drive being by internal gears. Windows have been replaced by fine wire gauze screens. The large rear door opens to the rear platform, which is lower than the main frame, gives an easy entrance and facilitates loading. The body space is 176 inches in length, with a maximum width of 88 inches.

In addition to this type of truck, there are a number in use to meet the needs of smaller units which cannot be economically supplied by a vehicle carrying over 3000 lbs. These trucks are 30 h.p. touring car chassis fitted with pneumatic tires and having a special meat-carrying body.

Switzerland

[Use of the Automobile in the Swiss Army. By Capt. Luis Fernandez Herce. *La Guerre y su Preparación,* Oct, '17. 3200 words.]

The lessons learned by the belligerents in the present war have been profited by in Switzerland where motor transportation has been highly developed. Trucks have been built at the Arbenz, Berna, Franz and Saurer, and Martini works which can climb 25 degree grades without difficulty. The 3½ ton truck is the most used.

The gas shortage has become serious since Rumania and the United States have entered the war, the annual consumption in Switzerland being 15 million liters. This shortage has been met by introducing benzol as a gasoline substitute, but as benzol freezes at +3° C., "naphtha-solvent" is added to it for winter use.

The Swiss Department of Public Economy has lately imported great quantities of a special fluid called "winter benzol," which has a freezing point of —10° C. and can be employed in all seasons. Winter benzol has been adopted for army uses.

The increasing lack of gas has caused the Department of Public Economy to issue monthly gas cards to consumers. In August, 1917, there were only 3,-000,000 kilos of gas left in Switzerland with foreign imports almost entirely cut off.

Gas carburetors are used with benzol by increasing the air in the mixture. A complete combustion results without residue. The Bosch company manufactures an auxiliary benzol carburetor for automobiles.

(The author gives the pre-war organization of trench transport trains in detail.)

Present Organization

The change from the old to the new organization took place during 1915 and by the fall of 1916 the "Corps of Military Automobilists" was completely organized. Its officers were chosen from the old organizations and the enlisted men from soldiers with mechanical knowledge.

Early in 1917 a school for candidates for commission in the auto corps was opened at Lucerne. The courses were military-technical and lasted six weeks. Lieutenants and corporals were graduated with chances for further advancement.

Sixty officers and 160 non-commissioned officers were selected from the line troops and added to the graduates.

The present corps of automobilists is under the General Staff.

Matériel—Wagons

Cantonal department commanders assist the Chief of Staff in mobilizing and conscripting the matériel. All wagons, etc., submitted for conscription are assembled at certain points, and those intended for troops and staff organizations are immediately despatched to their destinations. Those designated for the general reserve are sent to a general replacement depôt, where repracement matériel and personnel are assembled. Everything is immediately put in a serviceable condition. There is a second mobile depot near this on which dispatches vehicles and gasoline direct to the troops.

Trucks

Trucks are infinitely more economical than horse transportation—they can work longer and at a smaller expense, at the same time saving livestock for the agricultural army.

The Swiss army has 70 trucks both two-wheel and four-wheel drive. These are supplemented by requisition in time of war. Truck dealers and operators receive a cash compensation for the use of their trucks, which will be returned at the end of the war. Unity of type is encouraged by the government.

Motor-traction for Cannon

The belligerents have used everything from 5-ton trucks to side-car machines for replacing horses in moving artillery. The Swiss army makes use of motors to move field pieces, howitzers and machine guns.

Trucks can carry 4000 kilos, and with a trailer, up to 6000 kilos, at a speed of 20 kilometers per hour, or 180 kilometers per day on the flat country and 100 in the mountains.

Transportation of Heavy Weights

For this purpose the Swiss army makes use of the "Saurer" train. It consists of a tractor-truck and one or more trailers. These trailers can also be used with animal traction.

The Saurer tractor is a 3-ton truck with a 36 h.p. four-speed motor, and a 4.5 k.w. 110 volt electro motor, which may be used for electric lighting or other purposes.

This tractor is equipped with a special three-wheel trailer for carrying wire cable. The trailer is equipped with a special drum 2.50 by 1.25 meters and can carry five tons of wire.

Motorcyles

These are used for couriers, despatch riders, scouts and reconnaissance work. The three-wheeled side-car model is used for carrying men, especially the wounded.

The Swiss Motorcycle Corps was organized at the beginning of the war. Motorcycles were requisitioned. The personnel was chosen from line troops having mechanical knowledge and experience, licensed drivers being preferred.

Motorcyclists are armed with a short carbine. The troops of this corps are attached to division headquarters, brigade headquarters, and sometimes to regimental headquarters.

The side-car motorcycle has been used very extensively lately. In rainy weather it is practically an indispensable means of rapid communication, carrying two men over difficult roads at an average of 60 kms. per hour.

The 4 and 6 h.p. motors are principally used.

United States

[Q. M. C. Class A Truck Is Internal Gear Driven. *Commercial Vehicle,* Dec, '17. 1200 words.]

The Class A military truck is very similar to the larger model, the main difference being that it has an internal gear rear axle. The motor is considerably smaller but very powerful. At the governed speed of 1200 r. p. m. the power is 42½ h.p. and at 900 the torque reaches its maximum of 198 lb.-ft. The engine is 4¼ x 5½ in., 312 cu. in., has four cylinders in one block and mushroom tappets instead of the roller type. Detachable cylinder heads cover only two cylinders each. The valves are 1⅞ in. and the timing as follows: Exhaust opens 45 deg. early; exhaust closes 5 deg. late; intake opens 15 deg. late; intake closes 38 deg. late. The valve lift is 5/16 in. for both the intakes and the exhausts. The crankshaft is 2¼ in. in diameter; radiator cut down 4½ in.; connecting rods offset ¼ in.; clutch has 14 surfaces as against 18; transmission is smaller, rear end of aluminum case machined like face of bell housing; brake is 7 in. in diameter and 6 in. wide, having two external shoes contracted by a cam action.

The internal gear rear axle is an entirely new light design. The brakes are completely protected from lubricant and have great accessability. The differential is easily removed. The gear ratios are slightly higher. Hotchkiss drive is used and the equipment is the same as the heavy truck.

[Class AA ¾-Ton Truck Biggest Accomplishment in Government Standardization. *Commercial Vehicle,* Jan, '18. 2000 words.]

This truck is adapted not only to the uses of the Quartermaster Corps but also the work of the Navy, Marine Corps, Bureau of Docks, Signal Corps, Medical Corps and for cantonment work.

The new truck will differ from the other standardized models in that it will be bevel driven; will be fitted with an electric starter, a vertical finned tube radiator with a pressed steel casing instead of cast steel with cooling fins; will have two electric headlights attached to the radiator instead of to the dash, and will have a speedometer driven off the gear set. It will be equipped with Kellogg air pump driven off the gear set for inflating tires.

Every part has been made as easy to get at as possible, and a great number of pressed parts have been employed to reduce weight. The frame is pressed steel with four cross members, the radiator tanks are pressed steel also, as are the dash, cowl, running boards, fenders, fuel tanks and torque arm.

The power transmission is from the engine thru a Thermoid fabric universal joint to the three-speed gear set mounted amidships and thence thru a short propeller shaft with two metal universal joints to the bevel-driven rear axle. The clutch and gear set can be removed without affecting the engine or steering gear or column.

Brief specifications of the truck are as follows: wheelbase, 130 in.; tread, 56 in.; turning radius, 21½ ft.; wheels, 36 in., wood and steel; the frame is straight sided with overall length of 179 in.

[Specifications for Chassis Assemblies of Class B Army Trucks. *Commercial Vehicle,* Feb, '18. 1800 words.]

1. *Trucks.*—All must be assembled complete by chassis builders.

2. *Front Axle.*—Spring seats must be properly centered on axles, all spring leaves in proper alignment, spring clips tight, spring bolts locked.

3. Wheel bearings must be greased and kept covered until ready to mount wheels.

4. *Rear Axle.*—Spring pins and bolts must be well lubricated and all nuts locked; spring clips tight.

5. Housing shall contain the proper amount of lubricant and not leak at any place; hub bolts shall be drawn tight.

6. *Engine.*—All bolts holding engine to frame must be tight and nuts locked. Spark control rods to be adjusted and of such length that full advance and retard of spark can be obtained by the lever on steering column, throttle control rods likewise.

7. Intake manifold gaskets shall not leak and must be shellacked in place, all nuts tight.

8. Valve toppets must be set to standard openings: Inlet, .003 to .006; exhaust, .005 to .008.

9. No oil leaks will be permitted in any part of the engine, particular attention being paid to crank case.

10. Radiator and water connections must be water tight.

11. *Clutch Mounting.*—The clutch must engage gently and not slip under full load. Adjusting nuts and springs must be tight and locked. Pedal shaft is not to bind and all connecting link pins are to fit properly. All connections and bushings to be properly lubricated; propeller shaft must run true between centers.

12. Care must be taken in assembling annular bearings and no races injured.

13. *Transmission.*—Must be in proper alignment,

MOTOR TRANSPORT—Continued

case not damaged or strained, all bolts tight and nuts locked.

14. Shifting rods must be properly connected and pins cottered and oiled. Must contain proper amount of lubricant, gears to shift easily, no leak at any point.

15. *Drive Shaft.*—Must run true between centers. Universal to be properly lubricated.

16. *Brakes and Brake Rods.*—All yoke pins must be lubricated and cottered, lock nuts at turn buckles tight, rods to have proper length for adjustment. Bands must be concentric with brake drum; brake lining to have good surface and touch drum at all points. Brake equalizer must be adjusted properly.

17. *Wheels.*—All bearings to be loose enough to allow wheel to revolve freely, tight enough to prevent wabbling. Bearings and hubs to be packed, hub caps tight. Bolts in driving flange of rear wheel must be tight with nuts locked.

18. *Radiator.*—Must be perpendicular to frame. Fan must clear radiator at all points. All water connections must be tight.

19. Radiator guard must be perpendicular to frame at proper distance from radiator.

20. *Dash.*—Must be set at the dash line perpendicular to frame.

21. Side lamps to be securely fastened, completely connected, and in operating condition.

22. Floor boards to be properly fitted.

23. *Seat.*—Securely fastened so that it does not interfere with the operation of any part.

24. *Hood.*—Must be good fit at both dash and radiator. Clamps must be in proper place and hold hood securely.

25. *Steering Gear.*—All connections to be lubricated during assembly and securely fastened and locked.

26. Front wheels must be lined up and have the same amount of throw each way. Steering arms shall not interfere with axle at any point. All connections to be packed in grease and covered by leather boots.

27. *Fuel Tank.*—Tank straps must be very tight. Tank must fit dash and not leak.

28. *Bumpers.*—Bumpers must be in place with springs at proper compression.

28. *Tow hooks* must be tight with nuts locked.

29. *Fenders* must be free from vibration.

31. *Electrical Equipment.*—All connections must be properly made and all contacts free from dust. Wiring to be so done as to make a short circuit impossible.

32. *Battery* must be securely fastened and contain proper amount of electrolyte.

33. *Ammeter* on dash must show 7 to 8 ampere charge.

34. The *lighting and ignition switch* must operate properly.

35. *Dash lights* must be connected and operate properly.

36. *Tail light* must be securely fastened to bracket and operate properly.

37. *Muffler.*—Muffler must be securely fastened to frame by brackets.

38. *Exhaust pipe* joints at muffler and manifold must be free from leaks.

39. *Sprag.*—All connections of cable must be secure. Raising and lowering mechanism shall operate properly.

40. All pin connections and pulleys must be well lubricated.

41. *Painting.*—Entire chassis covered with a coat of best quality rust-resisting metal primer, then two coats of best quality paint (olive drab color).

42. *Lubrication.*—The engine, transmission, axle, steering gear, spring brackets, and all grease cups, etc., must be filled to proper level with approved lubricant.

[The Motor Transport Corps. Editorial. *Army & Navy Jour.*, Oct 26, '18. 1000 words.]

The Motor Transport Corps has been placed under command of Brig.-Gen. C. B. Drake. The program is extensive and calls for 24,250 motor cycles, 40,803 trucks, 7905 passenger automobiles and 6598 ambulances for each field army. Plans have been made for schools to be under the training branch of the corps. The course for drivers will be three and for mechanics six weeks. The program calls for more than 400,000 men to be in France by March, 1919.

New machines only will be sent to France. Six districts have been formed in the U. S., each with a central repair unit, for maintenance of the motor equipment in this country, so that old trucks may be kept in service as long as possible.

Each district is to be commanded by a motor transport officer appointed by the chief of the corps. Class 1 vehicles are those operated directly by the motor transport corps. Class 2 vehicles are those assigned to various units outside the Motor Transport Corps. The latter is responsible only for repair and maintenance of these vehicles.

In Class 1 are included new trucks moved in convoys from factories to seaboard. This saves doubly in transportation, as the trucks carry freight in these trips. Thousands of tons of freight are moved in this way. Recent graduates of the training schools handle these convoys, and thus gain experience in road work under the rules of the A. E. F.

—Trailers in

[Government Standardizes War Trailers. *Commercial Vehicle*, Jan, '18. 1000 words.]

Several types of standardized trailers are being made for the army, among which is a 1½-ton, four-wheeled, reversible or double-ended type. This trailer will be used behind the Class A war truck. The Signal Corps will have a two-wheeled pneumatic tired trailer. A two-wheeled trailer with a load capacity of 2 tons has been designed for General Pershing's force.

The 1½-ton four-wheeled trailer has a wheelbase of 72 in., a tread of 60 in. and a height of floor above the ground of 42 in. It is mounted on 36-in. wheels and has 4-in. solid tires. The frame length is 126¼ in., which is sufficient to carry a standard Class A2 M.C. body.

Many Class A truck parts are used, including front springs, spring shackles and brackets, tie rod and everything on the wheels outside of the king bolt. The frame is of 4-in. channels, with springs spaced on 36¾ in. centers. All springs are shackled so that they take none of the driving loads, the drive being taken thru the frame by means of a two-part draw-bar with a spring coupler of composite design.

The Signal Corps two-wheeled trailer will be mounted on 35 x 5 pneumatic tires and will have a body about 21 feet long and 5 feet wide. It will withstand speeds up to 30 m. p. h. and will be used to carry airplane wings and other parts. Its capacity will be about 1 ton.

MOTORS

See also
AERONAUTICS—MOTORS
BENZ MOTOR
PEUGEOT MOTOR
SUBMARINES—MOTORS

MOUNTAIN ARTILLERY

—Tactics

[Mountain Guns in Mountain Warfare. By Maj. F. O. Wyatt, M.V.O., R.A. *Jour. United Service Inst. India,* Jan, '18. 4200 words.]

In trench warfare the activities of both infantry and artillery are limited to certain spheres and do not partake of the mobile and varying conditions of the hillside; so that co-operation between the two is more a matter of organization than intercommunication. In mountain warfare artillery seldom gets the opportunity for indirect series and the guns are therefore brought well up in close support of the infantry. Under these conditions artillery personnel and matérial are very vulnerable to enemy fire and, unless the artillery commander is in the closest touch with the movements of the infantry, he is continually faced with the problem of withdrawing his fire at a time when support would be most valuable, or of running the risk of losing his guns or inflicting loss on his own infantry.

During the attack the artillery commander should know not only the initial dispositions but the various occurrences, anticipated moves, and particularly any information regarding enemy movements. The battery commander should be in touch with his guns, and the division commander should take his position in this vicinity.

Battery commanders will endeavor to keep a section ready to push forward at the first available moment behind the infantry, when it will probably be able to administer heavy punishment to the retiring enemy from the captured crest. This section's departure should be so timed that it will arrive almost simultaneously with the infantry capturing the ridge.

During a retirement, it is greatly to the advantage of the artillery support if the rear guard commander can be with the battery commander, that is, always within 1500 yards from his rear party. The artillery endeavors to work so that sections of guns are in position along the lines of retirement about 1200-1500 yards behind each other. In this way the whole of the ground along the line of retirement can be brought under artillery fire from the sections of guns, and fire maintained irrespective of sections coming out of action to retire.

This is accomplished by having the battery in action at the point from which the retirement will commence with only the firing battery, bare back mules and the minimum number of ammunition boxes. The remaining mules go back under the captain who selects the position for the next section. This position will be chosen so that it affords a good field of fire, is as immune as possible from attack, and is capable of easy and quick evacuation in the direction of the line of retirement.

Just before the timed retirement begins the battery commander orders back two sections, leaving one in action. When they arrive at the first line mules, one section will occupy the position chosen and the other will accompany the captain and the first line mules to the second position he selects. It is necessary that the battery commander should be in close touch with the rear guard commander so that he can be informed when he may retire his guns.

One section only should be sent out with the advance guard, as it is necessary that this body should be compact and in the event of an attack, it is almost inevitable that the leading section will have to drop into action before the full development of the tactical situation. For the battery commander to come up with his reconnaissance officer is only a matter of a few seconds, when he can dispose of his sections from the main body to the best advantage without, as would be the case were they on the advance guard, blocking the road to other troops.

The advance guard commander should tell the artillery commander any information he has regarding the proximity of the enemy, point out to him accurately where his pickets are to be placed and tell him at the time when they are being despatched. The artillery commander will make himself acquainted with the ranges to the various picket posts and surrounding hills, taking angles of sight where it is necessary and generally accumulating the information required to bring his section into action without delay.

The attachment of one section to the rear guard is unsatisfactory and is only a preventive measure in case of necessity. The section should march with its own escort at the head of the rear guard main body, and accompanied by its section commander. In the event of the picket being attacked he will bring his section into action with as little delay as possible. Where the ground and picket positions are well known to troops who work regularly in that locality, it is generally possible to move the section well forward and drop it into action at some point of vantage covering a danger zone.

The chief difficulty in intercommunication has always been that, altho the infantry may be willing and anxious to give advice of enemy movements, they very seldom know the way to do it, so that the artillery can bring fire to bear on the point without waste of

MOUNTAIN ARTILLERY—Continued

time involved in sending an observation officer forward.

All the information required can be given quite simply by infantry or by a single picket. The commander first calls up "B. C. O." and imagines that his light forms the center of a clock on which the B. C.'s light is at six.

And so the following conclusions are drawn:

The artillery must work in the closest conjunction with the infantry, if results of value are to be attained. The intercommunication must be more intimate than can be supplied by field signalling apparatus. The artillery commander is trained in selecting positions from which he can cover the largest field of fire.

Let the officer commanding keep with the artillery commander and directing operations from there, gain the best view of the action before him, and working in close conjunction with his artillery get the best use out of his guns.

[Field Problems for Mountain Artillery. By Lt.-Col. Antonio Beingolea. *Boletin del Ministerio de Guerra y Marina* (Peru), Jan, '18. 6000 words.]

6th Problem

Reconnaissance of the Artillery Group Position.—Time is gained when the group commander and his liaison agents advance themselves during the approach to a position. It should be attempted to enter into action rapidly so as to surprise the enemy. To do this the personnel must be thoroly instructed in working rapidly and accurately *under cover.*

The group commander's reconnaissance includes:

(a) Examination, on the terrain, of the situation and of his mission.

(b) Distribution of batteries and their duties.

(c) Selection of O. P. for group and batteries.

(d) Determination of emplacements and positions of limbers.

(e) A study of the various means of maintaining command of his group.

Battery commander's reconnaissance should include a careful survey of the battery front, the locating of the directing piece if possible, the determination of the B. C. post, location of limbers, and the placing of necessary telephone or signal lines between B. C. and firing battery.

The author then takes as a specific case the location of a group of artillery so as to cover a defile. The artillery group is supposed to be located on or near a crest. The batteries are arranged so that the interval between batteries does not exceed the distance between them in depth.

In order to secure the most effective fire, and the proper arrangement of batteries in echelon, the author goes into a mathematical discussion which should be read in the original.

From this discussion several rules are deduced by which the battery commanders may select their positions with more or less rapidity.

MOUNTAIN WARFARE

See also

MOUNTAIN ARTILLERY

MULES

See also

HORSES

MUNITIONS

See also

ARSENALS
EXPLOSIVES
POWDER
PRIMERS

—Manufacturing Facilities of

Belgium

[Military Industry of Belgium During the War. By Patricio Prieto. *Memorial de Artillería,* May, '18. 7200 words.]

The loss of Antwerp and Liège entirely destroyed Belgium's military productiveness. The most important factories at these two places were the Royal Cannon Foundry, the National Arms Factory, belonging to the government, the Construction Arsenal and the School of Pyrotechnics.

The cannon foundry manufactured the 7.5 cm. Krupp gun, projectiles and ammunition for the 12, 15, 21 and 24 cm. pieces in the Belgian forts. They also did a great deal of repair work on both guns and carriages, and kept the old matériel up to date.

The private factory of Cockerill at Seraing was manufacturing artillery matériel of various types. Powder was manufactured at the national works at Coulille and Wetteren. The invasion of Belgium was so rapid that the country's forces were deprived of all supplies and munitions almost immediately.

Provisional steps were taken to secure an adequate supply of munitions shortly after the fall of Liège by establishing temporary factories at Antwerp. The Minerva Auto Company's shops at this place were made use of, and machine guns were mounted in the requisitioned automobiles. A reserve transportation park was also created at Antwerp. The new installations at Antwerp were used until Sept 29, when everything had to be transferred a second time to Ostend. This transfer was made on account of enemy pressure and was completed on Oct 7.

Upon the evacuation of Ostend in the middle of October, everything that had been saved from the government arsenal and the government foundry, the arms factory, and the automobile or transportation park at Antwerp, was transferred to Calais. At the same time the remains of the Pyrotechnic School were transferred to Le Havre, which became the new national capital.

At the opening of the great battle of the Yser, the Belgian Army had 50,000 rifles, with a plentiful supply of ammunition, 350 field pieces with 600 rounds per gun, twenty-four 15 cm. howitzers with 150 rounds per gun.

The real crisis in ammunition and guns came shortly after Oct 26, when the Yser battle was at its height. All the artillery was in an unserviceable condition due to hard usage, and there was very little artillery ammunition and no rifle ammunition available.

By the end of October, the shortage of small arms

ammunition was made up by the arrival of shipments which had been ordered from foreign countries at the opening of the war. The artillery ammunition was loaned by France and the Creusot works supplied 15 cm. ammunition in sufficient quantities for the immediate necessities. Repairs of all sorts were taken care of in the new Belgian shops which had been installed at Calais.

By the first week in November, the new shops at Calais and at Le Havre were able to repair guns and produce ammunition at a satisfactory rate. And by Dec 31, 1914, the Belgian factories were receiving raw material from England and France and constructing a great part of their ammunition and matériel. (The author gives figures of the actual output of the various factories for periods ranging from one to six months between Dec 31, 1914, and July 1, 1915.) On Dec 11, 1914, an explosion in one of the powder factories destroyed several hundred skilled workmen.

On Aug 16, 1915, a royal decree reorganized the Belgian industries so as to meet the necessities of war. All private concerns were done away with and as Calais was too near the battle zone, the port of Le Havre was designated as the Belgian industrial center. A directorate of all industries was established in connection with the Bureau of Inventions in Paris, and with an office in London. Factories for the production of munitions, cannon, gun carriages, wagon transportation, metal parts for autos, saddles and harness, small arms, and a big repair factory for autos, were all ordered to be established. Repair factories and general warehouses were authorized.

In order to select the new bases and develop the new organization various officers, mostly from the artillery, were placed at the head of the work.

The auto construction shops were located at Sainte-Adresse, where the artillery matériel was also to be constructed. New shops were built at Graville to produce wagons, artillery carriage wheels, and accessories. Some artillery and engineer warehouses were also located here.

Th Belgians took over a small arms factory in Birmingham, England, installed a Belgian personnel and started to construct their own small arms.

Powder and explosives were purchased from private concerns and from the Allied governments and shipped to the Belgian factories. It was found that trinitrotoluol was the most economic and effective general utility erplosive.

All experimental work was carried out at the Schneider proving grounds at Harfleur, near Le Havre.

A total Belgian personnel of 160 engineers and officers and 16,000 workmen and women was taken from the old Belgian Militia and from the soldiers classified as fit for the auxiliary services under the royal Belgian decree and law of July 21, 1916, which called all Belgians between 18 and 40 years of age to the colors.

The male workmen are organized into companies and battalions. They live in wooden barracks, and are subject to military discipline. Everyone works 10 hours every week day and 6 hours on Sunday.

One of the most important factories built under the decree of Aug 16, 1916, was a precision factory for the centralization and unification of "small parts" of various kinds which it was impracticable to have constructed at any general shops.

From his observations the author draws the following conclusions from the Belgian production situation.

1. Private and individual industry was incapable of meeting the Belgian needs. The state itself had to furnish the army with necessities.

2. The construction of a "precision factory" (above mentioned) became necessary while the war was going on.

3. Specialized workmen had to be found and were taken from other factories where products were not essential towards winning the war.

4. War brought out the importance of machine guns, heavy artillery, and trench artillery.

5. The necessity for heavy artillery of over 15 cm. caliber was not very great.

6. For firing against airplanes and balloons, the regulation field gun on a special mount was found effective.

7. The explosive most used is trinitrotoluol.

United States

[2,000,000,000 Mark Passed in Manufacture of Cartridges, While 1,886,769 Rifles and 82,540 Machine Guns Have Been Produced. *Official Bulletin*, July 24, '18. Quoted.]

The War Department authorizes the following statement from the Ordnance Department:

The United States has passed the two billion mark in the manufacture of small-arms ammunition.

Since this country entered the war, and up to and including July 19, 1918, the total output of cartridges for rifles, pistols, revolvers, and machine guns, inspected and accepted, was 2,014,815,584. The daily average output is approximately 15,000,000. The maximum number inspected and accepted in a single day was 29,466,000 on July 5.

The latest figures available on the production of small arms, including rifles, pistols, revolvers, and machine guns, inspected and accepted, are up to and including July 13, 1918. They show:

Total number of rifles of all types......	1,886,769
Total number of pistols, Model 1917...	217,000
Total number of revolvers, Model 1917.	169,367

The total number of rifles given does not include the 600,000 Springfield rifles which the government had at the outset of the war, nor does it include the thousands of complete rifles represented by the spare parts manufactured. It does include 1,417,284 rifles of the U. S. Model 1917 type, and 280,049 Russian rifles taken over by this government.

The production of rifles for the week ending July 13 was 54,211, inspected and accepted; pistols, 8700; revolvers, 6104.

Figures for machine guns show a total number manufactured, inspected, and accepted, up to and including the week of July 13, 1918, of 82,540. The total production of all types during that week was 6681, or 1564 in excess of the previous week's production.

MOUNTAIN ARTILLERY—Continued

Production of Browning machine guns since we entered the war has amounted to 10,204 light Brownings and 5959 heavy. During the week ending July 13 the production was 2018 light Brownings and 1075 heavy. In both instances the numbers represent machine guns actually inspected and accepted.

[27,000,000 Cartridges Made in One Day for U. S. Troops. *Official Bulletin*, July 5, '18. Quoted in part.]

The War Department authorizes the following statement from the Ordnance Department:

American records for daily production of ammunition for rifles and pistols were broken on June 27, when approximately 27,000,000 cartridges of every description were produced in plants manufacturing for the United States Government. This figure includes no cartridges manufactured commercially or for other governments. The twenty-seven million should not be regarded as an average production figure—only as a high record.

Rifle Record Broken

The daily average for the production of United States Army rifles of the models of 1917 and 1903 was broken in the week ending June 29. An average of 10,142 rifles of these types—the modified Enfield and the Springfield—was maintained, 55,794 rifles being produced, together with spare parts, equivalent to several thousand rifles. Russian rifles to the number of 3280 also were manufacured.

[More than 2,000,000 Rifles Produced Since United States Declared War. *Official Bulletin*, Aug 7, '18. Quoted.]

The War Department authorizes the following from the Ordnance Department:

The United States Government has passed the two million mark in the production of rifles since war was declared.

Up to and including July 27, 1918, the total number produced, inspected and accepted was 2,000,798. This number includes, in part, 1,523,156 of United States Model 1917 and 280,000 Russian rifles. It does not include the 600,000 United States Model 1903 (Springfield) rifles estimated to have been on hand when we entered the war.

During the week ending July 27, the total number of rifles of all types inspected and accepted was 59,167—an increase over the previous week's production of 4305. Of this 59,167, 53,310 were United States Model 1917 rifles, the week's production of which exceeded production during the week previous, by 2748.

Machine gun production continues to show a steady increase, altho the output of all plants fluctuates. The number of heavy Browning machine guns inspected and accepted during the week ending July 27 was 1106, a decrease of 257 under production for the previous week. Light Brownings, inspected and accepted during the past week, reached a total of 2624, an increase of 557 over the previous week. Since the war began, and up to and including July 27, the total number of machine guns of all types, produced, inspected and accepted was 96,006, including 8428 heavy Brownings and 14895 light Brownings.

The total output of pistols and revolvers, inspected and accepted, up to and including July 27, was 414,015, including 235,700 .45 Model 1911 pistols and 178,315 .45 Model 1917 revolvers.

[3,000,000 Hand and Rifle Grenades Being Made Every Month for Army and Production Soon to Be Doubled. *Official Bulletin*, Aug 1, '18. Quoted.]

The War Department authorizes the following from the Ordnance Department:

Hand grenades of four types are now being produced at the rate of 2,000,000 a month, it is announced by the Ordnance Department.

Within the next four months, according to program, this rate will be more than doubled.

Rifle grenades are being produced at the rate of about 1,000,000 a month. This rate will be multiplied appreciably within the next six months.

Orders have been placed for more than 60,000,000 grenades of both hand and rifle type, and more than 18,000 persons are employed in various plants thruout the country engaged in making them.

Of the hand grenades under manufacture, there are two types of the so-called fragmentation grenades, which depend on the effect of explosives and the scattering of fragments; one type of phosphorous grenade, which, on bursting, throws a shower of burning fragments of phosphorous and a cloud of dense white smoke, and a gas grenade, which spreads a low-lying cloud of dense white suffocating gas.

The soldier throws the hand grenade much after the manner of an athlete putting the shot. When ready to throw the grenade, he grasps it firmly in the right hand, removes the safety pin, and keeps the lever tight against the body of the grenade. As it leaves the soldier's hand, the lever is released, and a firing mechanism is timed to explode the grenade in from four to six seconds after it is thrown.

The rifle-grenade holder is attached to the muzzle of the rifle much as a bayonet is. The bullet from the rifle passes thru a tube in the center of the grenade, forcing a striker against a primer, which ignites the fuse. The grenade is thrown a distance of 200 yards by the force of the gases generated by firing the rifle. The grenade is timed to explode about eight seconds after it leaves the rifle muzzle.

[U. S. Machine Gun Production Has Passed the 100,000 Mark. *Official Bulletin*, Aug 19, '18. Quoted.]

The War Department authorizes the following:

The United States has passed the 100,000 mark in the production of machine guns. The Army Ordnance Department announces that 108,973 machine guns of all types have been inspected and accepted since the country entered the war. The figures are up to and including Saturday, Aug 10.:

Of this number, 30,226 are Brownings—11,187 of the heavy-type gun, 19,039 of the light automatic rifles. In the week ending Aug 10, 6228 machine guns of all types were inspected and accepted. In this week, 1354

heavy Brownings and 2035 light Brownings were accepted by the ordnance inspectors.

[Army Items. Ordnance Has 2,033,638 Rifles. *Army & Navy Jour.*, Oct 26, '18. 100 words.]

To Oct 12, 2,033,638 model 1917 rifles had been produced. 40,814 rifles of this model were accepted in the week ending Oct 12.

The total of rifles since the U. S. entered the war is 2,591,631, not including the 600,000 Springfields on hand when war was declared.

MUSIC, Military

[Music in the Swiss Army. By Lieut. E. Lauber. *Revue Militaire Suisse*, Feb, '18. 1500 words.]

Since 1914 little in the Swiss Army has escaped change, and this applies to music in the army as well as to other things. Until the late Col. Loys, in command of the Second Division, became interested, there was little progress in instructing bands and their leaders, altho the improvement of the fighting units was made by leaps and bounds. But he stimulated interest in other chiefs, and a serious effort has been made to improve bands. The band is to train the battalion, but to do so it must be trained itself. During exercises at a halt all goes well in the ordinary band, but marching is different. After a few miles most of the instruments can scarcely play at all, and as to ensemble, sonority, and vigor, it is lacking altogether. The trouble is that the musicians cannot march and play at the same time, and this is because they are not trained to do it. Rigorous exercises are used in the Second Division with wonderful results, both individual exercises and marches. This, with an encouragement of the musical spirit in the recruit, has been found to work wonders.

NAPOLEONIC WARS—1815

See also
WATERLOO, BATTLE OF

NAVAL OPERATIONS

See also
AERONAUTICS—NAVAL USE OF
COAST ARTILLERY
DIRIGIBLES—NAVAL USE OF
EUROPEAN WAR—GENERAL NOTES—NAVAL OPERATIONS
SHIPS AND SHIPPING (MERCHANT)

—Cost

[Fifty Million Dollars An Hour. *Canadian Military Gazette*, Nov 27 '17. 150 words.]

It is estimated that the cost of a single hour of combat between the British and German fleets engaged at anything like their full strength would be $50,000,000. This estimate is based on the cost of the Jutland battle which was $200,000,000 without counting the value of the lives sacrificed. Only a portion of the two fleets was engaged in this battle.

NAVY

See also
COAST ARTILLERY

—Losses

Great Britain

See
GREAT BRITAIN—NAVY—LOSSES

—Naval Policy

United States

See
UNITED STATES—NAVAL POLICY OF

—Ships and Matériel

See also
MOTOR BOATS
SUBMARINES
SUBMARINES—DEFENSE AGAINST

[Dummy Ships That Fooled the Germans. *Popular Science Monthly*, May, '18. 500 words. Illustrated.]

At the beginning of the war, fourteen Canadian Pacific S.S. Co. steamers were converted, by means of canvas and wood additions, into exact outward duplicates of vessels of the Grand Fleet. These dummies were used to deceive the Germans, and their use explains some of the discrepancies in reports. The deception was not discovered until after the lapse of fifteen months.

NEUTRALITY

—Violation of

[The Value of an Oath. By V. *Revue Militaire Suisse*, Sept, '18. 1300 words.]

Switzerland now has 40,000 foreigners who have taken refuge within her borders. These are composed principally of deserters and of defaulting conscripts; next come political refugees, spies, and fugitives from justice in the belligerent nations. These people, not content with the hospitality of Switzerland, have defied her laws, imposed upon her people, and now seek to undermine her institutions and traditions by proudly, openly, and shamelessly boasting of their cowardly conduct.

That which most disgusts the Swiss is the fact that all these people were false to their word in their own countries. This rankles keenly in the bosom of a nation with whom their pledged word is their religion. Switzerland may well be proud of her record for keeping faith, and her people love to point with pride to the high sense of honor which has been their national characteristic for so many generations.

The Covenants of Sempach and Stans, and the Ordinances of Berne in 1410, 1443, 1481, and 1490, all condemn deserters and those who seek to evade their duty, sentencing them to perpetual banishment. Now the Swiss are demanding that justice be meted out to all who break a sworn oath, be it individual or government, citizen or alien. In their eyes nothing can be mode despicable and contemptible, and not only have these undesirables won the wholesome contempt of the Swiss, but now they demand that they be driven back to their native lands where they will be subject to their own laws.

In Switzerland it is now a popular contention that to harbor these undesirable aliens is to tacitly approve

NEURALITY—Continued

of their dishonorable conduct, and to do so is to dishonor the Swiss dead, who like the Swiss Guards at the French Court on Aug 10, 1792, died, not for a king, nor even for a country, but as stated on the pedestal of the Lion of Lucerne, *"Faithful to their word."*

NORWAY

—History

See also

CANUTE THE GREAT

NURSES AND NURSING, Military

See

SANITARY SERVICE—NURSES

OFFICERS

See also

COMMAND OF TROOPS
COMMAND OF TROOPS—QUALIFICATIONS FOR
SCHOOLS, MILITARY—OFFICERS' SCHOOLS
UNITED STATES—ARMY—OFFICERS

[Officer and Soldier in War. Experiences from the German Battle-front. Correspondence from Germany. *Schweiz. Monatschrift aller Waffen,* July, '17. 1200 words.]

It may appear that the task of the commander whose post is a kilometer behind the firing line is easy compared with the task of the soldier on the line. The contrary is true. The actual fighter is sustained and his initiative and resource stimulated by the contact with the enemy. He fights with his eyes open. The commander in the rear has no such stimulus to his zeal and to his intelligence. He must fight without personal knowledge of the situation. The soldiers in the line recognize that his task is harder, and only when hesitancy is displayed in an order, or when something impossible is demanded thru ignorance or oversight of the immediate conditions, does any soldier complain that the commander ought to come forward.

The plan of selecting officers from the higher social strata should be adhered to. The officers need moral and intellectual superiority, and this superiority belongs to the higher classes. However, a natural leader, from whatever class, is a better officer than a less forceful person of higher social grade.

It happens frequently in war that men of age and experience are subjected to the orders of comparative boys. As a general rule this causes no difficulties. The soldiers look up to the officer as the one who can understand the higher orders and who connects them with the higher command. Sometimes the officer does not fill the high rôle thus assigned him. Then the common sense of the soldiers comes to the rescue. There is little place for youthful whims in war.

The reserve officers form a connecting link between the regular officers and the population and prevent misunderstandings. A regular officer has much to gain from the war; the reserve officers come from the classes who have much to lose. The presence of the latter in the army is a warranty of the rightfulness of war.

—Instruction and Training of

[Japan, Regulations for Combined Maneuvers of the Land and Sea Forces. By Lt.-Col. Eduardo Herrera de la Rosa. *La Guerra y su Preparación,* Oct, '17. 4400 words. 1 table.]

1. Name of combined maneuvers shall be called "The Great Maneuvers of the Land and Sea Forces."
2. They shall be presided over by the Emperor, who will be present personally.
3. They shall be planned and executed by the Chief of the Central General Staff.
4. Plans for these maneuvers shall be submitted to the War Minister, the Minister of Marine, and the Inspector General, who will inspect and report thereon as to their practicability.
5. Transmission of all orders for the great maneuvers shall be done under the assumption that a state of war exists.
6. Opposing forces shall be greater than a division. a naval department, or a naval squadron. They will be held between military and naval forces, and between mixed forces.
7. The great army maneuver as well as the navy maneuver shall not be held the years that combined maneuvers are held.

Maneuver Trips for Officers

1. These shall be of three classes, *viz.:* The General Officer class, the Staff class, and the Troop Commander class.
2. The General Officer and Staff trips shall be under the Chief of Staff, the Troop Commander trip shall be under the Inspector General of Instructi n.
2. The object of the General Officer trip shall be o study by practice the higher art of handling troops and familiarize the participants with war operations.
4. The objects of Staff trips shall be to study and practice war operations of larger units and thoroly to familiarize the officers with the nature and importance of the duties of higher commanders and staff officers in war. This will include questions of sanitary service, military administration, supply service, tactics, strategy, and the handling of troops.
5. Troop Commander trips have as their principal object the instruction of officers in the tactical handling of troops. Marches, quartering of troops and combat will be thoroly studied. Supply problems in this case will be secondary and will be developed with the movement of the troops. Cavalry brigades may make marches to determine the limitations of their horses. These trips will be divided into five classes, *viz.:* Infantry division, Infantry brigade, Cavalry brigade, Field Artillery brigade and Coast Artillery brigade.
6. The General Officers shall operate with divisions and higher units. The artillery and infantry brigade officers will deal with a division. Cavalry brigade officers will deal chiefly with large bodies of independent cavalry. Coast and siege artillery will deal with coast defense and siege warfare.
7. Maneuver trips of each kind, once every two years, last from seven days to two weeks. Each class will consist of from 8 to 16 officers instructed by the

director of maneuvers and two or three assistants. (Given in table form.)

8. Each general officer of a class may take an officer on the general officer trip as secretary.

9 and 10. Brigade commanders and colonels may take the general officer trip, which shall be conducted by the Chief of Staff or Assistant Chief of Staff. Upon its completion a report will be sent to the emperor as to the abilities of the members of the class and the results attained. This report will then be sent to the Minister of War.

11 and 12. The staff trip class will consist of General Staff officers and officers who would join the General Staff in time of war. They will be directed as in 9 and 10. Officers of the sanitary and administrative services will also make this trip.

13. Officers for the troop commander trips will be chosen from each division, as well as four officers designated by the Minister of War, two from his own personnel, and two from that of the Inspector General of Instruction.

Detailed Regulations for the Maneuver Trips

The order prescribes in detail the supplies, livestock and enlisted personnel that may be detached from divisions for the purpose of this instruction. The division commander is ordered to inform the Minister of War three months before the troop commander trip takes place. The years in which the officers of each division take these trips are given in a table.

Regulations for Maneuvers of Supply Trains

The order prescribes that each year the Inspector of Supply Trains will convene the officers of each train with the object of technical study and practical work in supply service. Furthermore the supply services will co-operate with other services on the General Officer, Staff, and Troop Commander trips.

(The author concludes with a discussion of the autumn maneuvers of 1917, held in the provinces of Mino and Owari, in which the 3rd, 9th, 15th and 16th Divisions took part.)

[Leadership and Military Training. By Col. Lincoln C. Andrews, U. S. Army. 191 pages, 4½ x 6¼ in. *J. B. Lippincott Company*, Washington Square, Philadelphia. Price, limp leather, $2.00 net; limp cloth, $1.00 net.]

All accounts agree that the material making up the new armies of the United States is excellent. The vital needs of the day are training and leadership—and the leaders must largely be developed from comparatively raw material. The qualities for successful leadership are practically the same whatever be the walk of life. Some men make good leaders without really knowing the reason why. A few have an understanding of the principles that are involved and gain success by applying their knowledge. Many more, however, when placed in positions of responsibility for the first time, fail repeatedly in their attempts to become true leaders, before they attain final success—and often never do reach the goal—largely because they are not aware of the fundamentals underlying the thing they are trying to accomplish. The number of natural leaders is far too small to meet the demand of a modern army, where every fifth man must lead his fellows, in groups either large or small. The deficiency must be made up by developing in others this indispensable quality as rapidly and effectively as possible.

Colonel Andrews' book is an attempt to assist in meeting this great need by setting before the prospective leader the fundamental principles of successful leadership. The result is admirable. We find nothing of the drill manuals, nor of the technique of the art of war. The book is rather an analysis of the psychology of soldiering, getting at the spirit of it, pointing out how to become a successful leader and how to avoid making a failure. It is intended primarily for beginners to whom it should prove invaluable. Much of its contents, however, merits careful study by older officers, particularly those who have never given much thought to the psychology of their profession. There are few officers who would not profit by familiarizing themselves with its precepts.

Following the chapters on Leadership, Discipline and Morale, and the Psychology of Battle, the author takes up the subjects of Military Training and the Conduct of Drill. The reader is given a clear picture of the result that should be attained by training. Many hints are given on the minutiæ of drill—those points which are found in no manual, but which make all the difference possible in the results secured. The book ends with a valuable series of rules for Conduct, Courtesy, Health and Battle. The style thruout is clear and convincing.

ORDNANCE

See also
ARTILLERY—MATERIEL

ORGANIZATION

See also
ARMY—ORGANIZATION

PAUL SCHMITT AIRPLANE

[The Paul Schmitt Airplane. By John Jay Ide. *Aviation,* Oct 1, '17. 720 words. Illustrated.]

The Paul Schmitt airplane, one of the largest French tractor biplanes, is distinguished by a very ingenious means for varying the angle of incidence of the wings in flight. In the case of this machine, the body can be maintained horizontally at all speeds by simply changing the angle of the wings to suit conditions. The two main planes form a unit entirely distinct from the body, which passes between the planes without touching either of them. They are connected to the body by means of a transverse tubular shaft, resting in ball bearings on a pair of inverted V stanchions and bolted at their lower ends to the upper longerons of the body.

The ends of the transverse shaft are rigidly attached to two steel tubes placed fore and aft between the front and rear interplane struts. These four struts pass thru the body by means of slots in the covering and are connected transversely at top and bottom by other tubes. The wings are prevented from rotating around the transverse axis by means of a large nut working on a threaded shaft, borne on ball

PAUL SCHMITT AIRPLANE—Continued

bearings and attached longitudinally to the floor of the body. This nut is connected by two pivots to a pair of interplane struts.

The Paul Schmitt airplane is built practically thruout of steel. The body is built up of autogenously welded steel tubes. From the nose to a point just behind the seats, it is of rectangular section; to the rear of this the lower longerons converge, thus forming a triangular section. The elevator is very large and partly balanced. Behind the 160 h.p. Le Rhone engine, mounted between double bearings in the bow, are placed the tanks.

PEACE PROPAGANDA

See also
EUROPEAN WAR—PEACE NEGOTIATIONS

PENN, Admiral Sir William

[The "Grandfather" of Pennsylvania. By Percy Cross Standing. *United Service Mag.,* June, '18. 1500 words]

(A brief account of the life of Admiral Sir William Penn, the father of William Penn, founder of the Pennsylvania colony. Admiral Penn was one of the great admirals of the Stuart and Cromwell epoch, probably next to Blake the most eminent admiral of that epoch.)

PEUGEOT MOTOR

[The 200 H.P. Peugeot Aviation Motor. By E. H. Sherbondy. *Aerial Age Weekly,* Jan 21, '18. 1390 words. Illustrated.]

The 200 horse-power Peugeot Aviation motor is of particular interest to American engineers because of the remarkably successful racing cars which had been constructed by the Peugeot Company for four years prior to the war. All of these motors were built with the same characteristics, comprising four cylinders cast *en bloc,* with four overhead inclined valves per cylinder, operated by two camshafts. Owing to the remarkable success of these motors in road and track races, it was assumed that the design would be an excellent foundation for an aviation motor. This proved to be only partially true, and a long series of experiments were carried out before the Peugeot Company had built an aviation motor which was able to hold its power and to avoid mechanical troubles during a 50-hour run. Four cylinders of 100 mm. bore and 180 mm. stroke are cast *en bloc* with the water jacket. Four valves per cylinder are used, as was common to Peugeot racing car distribution. The valves have a port diameter of 44 mm. and an outside diameter of 48 mm. The valves operate in bronze guide bushings which are pressed into the cylinder. Two springs per valve have been found indispensable to satisfactory valve operation for high speed motors, the inner or secondary spring having a different period of vibration from the outer spring.

The pistons are 100 mm. in diameter and 90 mm. long, and are machined from solid forgings. Each piston carries two rings. The piston pin has an outside diameter of 21 mm. and a 14 mm. hole drilled straight thru. These pins are lubricated by spray thrown off by the big ends of the connecting rods. The connecting rods are of the forked type and are machined out of B N D steel. Connecting rod centers are 295 mm., giving a connecting rod to stroke ratio of 1.64 to 1. The crank shaft is mounted in three large double row ball bearings, which in turn are seated in bronze cases, retained in the crank case by means of long cap screws and spring washers. The oil is carried from the ball bearings to the crank pins by means of pressed brass banjo-drums, and thence thru channels drilled in the crank pins. At the forward end of the crankshaft there is mounted a spiral pinion for driving the oil pump, and a hand starting reduction gear and starting magneto gear.

The propellor shaft reduction gear is mounted in two annular ball bearings, one of them a double row bearing. These bearings are spaced about 350 mm. apart.

The lubricating system is the dry sump variety, of which the Peugeot Company was the originator. The oil is drawn off from the base by means of a double gear pump. After having been filtered and cooled in an oil radiator, it is pumped to the main ball bearings and various auxiliary shafts. The cam operates the valves by means of intermediary push rods which are of different form for the inlet and exhaust valves. Light steel manifolds serve to connect the eight exhaust ports of each of the cylinders to the central expansion chamber, which has a stack at its rear portion inclined at an angle of 25 degrees from vertical so as to discharge the exhaust above the upper wing of the plane. Each group of four cylinders is fed by a single carburetor. The carburetors are similarly disposed on the right and left sides of the motor. These carburetors are a development from the earlier type of Claudel racing carburetor. There are two main fuel passages to the jets; one feeding thru the compensating plug to the well, which supplies the necessary fuel during idling and acceleration, and a second calibrated plug which feeds the fuel for the main supply. The inlet pipes are jacketed and are heated by means of exhaust gas. Fuel consumption of this motor is 188 grams per h.p. The order of firing each group of cylinders is 1, 3, 4, 2.

PERISCOPES

—For Trench Firing

[A Mexican Invention. *Revista Militar* (Argentina), Sept, '17. 475 words.]

A Mexican engineer, Señor Pedro Rioseco, has invented an attachment to the ordinary military rifle permitting indirect fire from behind cover without exposure to the firer. The sighting apparatus consists of a small periscope in the form of an elongated Z.

The cost of the attachment is about six pesos. A very successful demonstration was given recently before the President of the Republic.

This device is now being manufactured in the Government Arsenal and it is proposed to put it in general use in the army.

PERU

—Army—Artillery

See also

FIELD ARTILLERY—INSTRUCTION AND TRAINING

—History

See also

YUNGAY, BATTLE OF

PHOTOGRAPHY

—Aeronautical

[The Camera at the Front. *Scientific American*, Nov 24, '17. 1400 words. Illustrated.]

Each of the big powers in the war has numerous types of aerial cameras now in use. At one time, when aerial warfare was still in its infancy, the French, British and Germans made use of small cameras of the hand type which were pointed over the side of the airplane in order to make a photograph. The Germans developed, for this purpose, an ingenious camera in the form of a long and slightly tapered body, equipped with a direct-view finder and a pistol grip. The shutter was released by pulling a trigger, and the entire apparatus was strongly suggestive of a revolver. This camera, like most of the others, was equipped with a focal plane shutter. But the demand for clearer, sharper photographs has given rise to big, long-focus cameras.

While details regarding the various cameras now in use are naturally most carefully guarded by the various nations at war, it is known that the present tendency is toward still larger cameras, which, in may instances, are built into the planes. The French are making use of a camera which measures over four feet in length, with a slightly tapered body ending in a lens board. The airmen refer to it as the "vest-pocket" camera. Obviously, such a camera could not be lifted over the side of the airplane nacelle because of the surface which it would expose to the onrushing air, and hence it is installed in the airplane body with the lens pointing down thru a hole or well, while the machine is maneuvered into position for making the exposure. An improved type of Italian camera automatically makes photographs at predetermined intervals on a strip of film, and as each exposure includes in one corner the image of a compass, the individual prints can be more readily assembled by the "readers" and compilers at headquarters, since the points of the compass are given with each one. In America there has been developed an ingenious camera which makes use of standard motion-picture film, and which, by means of a cable release, can be operated by the airman at any moment. From 1 to 750 exposures can be made on one roll of film, and because of the small bulk and the light weight of this equipment, it is quite possible for two or more cameras to be carried by one airplane, if desired.

[Military Aerial Photography. By M. Gervais-Couriellemont. *Flying*, Feb, '18. 800 words. Illustrated.]

The photographs which are now taken from aircraft at the front are of the utmost value to the reconnaissance service, which has become entirely dependent—based, in fact—on these hovering eyes of the army. At first, ordinary cameras were used and photos were taken at all angles, either on the vertical or oblique, according to circumstances, but the capture of German airplanes disclosed the enemy's perfected cameras, equipped with wonderfully precise lenses of very long focus (twenty inches). The photos are all taken vertically beneath the airplane in order to facilitate and expedite all calculations. A man may be seen in a photo taken from and altitude of 4500 feet, and, in clear weather, wonderful negatives are obtained at a height of 6000 and even 9000 feet, on 6 by 8 plates (French dimensions).

Every evening the aircraft send in to the photographic service the negatives taken during their reconnaissances of the day. At Headquarters these negatives are developed at night, the printing is done, and early next morning the prints are distributed by automobile. Every night hundreds of negatives are developed, prints are made and dried by the thousand; and the work must proceed quickly and with regularity. Proofs are dried in a couple of minutes on rough canvas heated from underneath with alcohol burners. The photos are so clear that, when enlarged, minute details of the enemy's lines are preceptible, such as "camouflaged" shelters and gun emplacements. Thanks to the aircraft co-operation, the French artillery established and maintained an unquestionable superiority which enabled us to recapture all the important points in front of Verdun on both banks of the Meuse, Dead Man's Hill, Pepper Hill, etc., and which leads us confidently to expect an eventual victorious offensive against Metz.

In the French aerophotographic services the position of the camera on the airplanes is similar to that of the English. We often use panchromatic plates with a yellow clear screen to distinguish painted from natural verdure. All camouflages are clearly reproduced with the panchromatic plates. Captured German cameras show that the Germans also use panchromatic plates.

PHOTOGRAPHY, Military

[Aerial Photography. By H. E. Haferkorn. *Professional Memoirs*, May-June and July-Aug, '18. 13,000 words. Indexed.]

(A list of 227 references to books and periodicals bearing upon the subjects of photo-topography and aerial photography. The bibliography is fully indexed.)

PHYSICAL EXAMINATIONS

See

EXAMINATIONS—PHYSICAL

PHYSICAL TRAINING, Military

See

GYMNASTICS, MILITARY

PIONEERS

See

ENGINEERS

PIRACY

—Suppression of

[The Freedom of the Seas. By G. E. Manwaring. *United Service Magazine,* Sept, '18. 1500 words.]

Attention is invited to the important rôle which, since England first became a sea power, the British Navy has played to keep the seas free from piracy. Not only is it now busily engaged in suppressing the ruthless piratical submarine warfare which Germany is using against the rest of the world, but for centuries piracy has been held in check due to the efficient part played by the British Navy.

Even at so late a date as the beginning of the 19th century, the pirates of the Barbary Coast were notorious. Trade in the Mediterranean was seriously menaced by these peoples who made it a profession to levy taxes on the traders, or to confiscate their cargoes and capture their crews to be enslaved or held for ransom.

The crisis was reached in 1816, when on May 23 of that year, over 300 Italian coral fishing boats were set upon and sunk, and their crews massacred as they were about to celebrate the Feast of the Ascension on the shore nearby. Altho this outrage was committed against Italians, England championed the cause and determined to rid the seas of these pests in the interest and welfare of the rest of the world. Lord Exmouth, then Commander-in-Chief in the Mediterranean was entrusted with the mission of abolishing forever any chance of any such recurrence. After due preparation he set out from Plymouth on July 28, 1816, with 2 three-deckers, 3 seventy-four gun ships, 5 frigates, and 9 gun-brigs and bomb vessels, a total of 19 vessels in all. At Gibraltar he found a Dutch fleet of 5 frigates and a corvette, which was eager to join in the same mission.

In the meantime, the Algerians having learned of the preparations of the British, had assembled an army of 40,000 men from the interior, and strengthened their coast defenses everywhere. These latter mounted some 500 guns of all calibers. Besides, in the harbor were anchored between 40 and 50 gun and mortar boats.

The British and Dutch fleets sailed into the harbor of Algiers on Aug 27, and Lord Exmouth immediately sent a flag of truce demanding the abolition of Christian slavery and the liberation of all captives. As the trucebearer did not return after 3 hours absence, Lord Exmouth decided to attack the city. In the general engagement which followed the Algerians made a daring attack on the *Queen Charlotte,* the flagship, and her consort, the *Leander.* Out of 37 gun boats which made this attack, the *Leander* sank 34 with her broadsides. The British victory was sweeping, and on the following morning the Dey accepted the demands of Lord Exmouth. This was the end of organized piracy in the Mediterranean. Under the stimulus of the glorious achievements of the past, the British seamen have resolved to rid the seas of the submarine pirates unleashed by the German Kaiser, and re-establish a true freedom of the seas not only for Great Britain, but also for mankind thruout the rest of the world.

PONTONIERS

See

BRIDGES, MILITARY—BRIDGE TROOPS
ENGINEERS

PORTUGAL

—Army

[The Portuguese Soldier. *Revista Militar* (Argentina), Oct, '17. 150 words.]

The Republic of Portugal intends to create an army worthy of its seven millions of inhabitants. Obligatory service has been imposed and an army of 600,000 men will shortly be placed upon a war footing.

The need for officers is so great that all those who have completed literary or scientific courses have been sent to officers' schools, the graduates of which are to be commissioned as second lieutenants in the new troops.

Many Portuguese officers are attending French and English aviation schools, returning with certificates as pilots.

—Naval Policy of

See also

AZORE ISLANDS

PNEUMONIA

See also

SANITARY SERVICE—PREVENTIVE MEASURES—INOCULATION

[An Epidemic of Measles and Pneumonia in the 31st Division, Camp Wheeler, Ga. By Lt.-Col. L. C. Duncan, M.C. *Military Surgeon,* Feb, '18. 4500 words. 1 chart.]

Camp Wheeler, at Macon, Ga., was the camp of the National Guard troops of Alabama, Georgia and Florida. The militia troops, who went into camp during September, 1917, numbered about 11,000 men, of whom probably 3000 were recruits of less than three months' training. During October about 10,000 drafted men arrived at the camp.

Measles had existed in the National Guard regiments from the time of their mobilization for service on the Mexican border in June, 1916. The disease had been kept under control, however, until the arrival of the drafted men at Camp Wheeler. Many cases were brought to the camp by those reporting, several being taken from the train with well developed attacks after they had been shut up for hours in closed cars filled with men. Under such conditions it is not to be wondered at that the disease got out of control.

The measles epidemic began on Oct 21 and was over by Dec 7. There were approximately 3000 cases among the 10,000 draft men. This figure of about 30 per cent non-immunes is worth remembering as representing a possible average.

A pneumonia epidemic began 10 days after the incidence of the measles and continued until the end of December, with a total of 701 cases. It appeared that there was a definite relation between the measles and pneumonia epidemics.

(The writer enters into a statistical discussion to show that the pneumonia epidemic was dependent upon that of the other disease. He develops his theme by a considerable amount of data of especial interest to medical officers. These include tables and notes based upon the hospital records of the camp, the writer's con-

clusions therefrom and a list of the preventive measures that proved efficacious in stamping out the epidemic.)

Pneumonia has been *the* disease of the camps of 1917-18. It occupies relatively the same place that typhoid did in the camps of 1898. Twenty per cent die (30 per cent of the measles pneumonia), while at least 10 per cent more will have to be discharged.

It is interesting to note that, with approximately equal numbers of men in the two classes, there were ten times as many cases of pneumonia among the men of less than eight months' service as among those with more than that length of service.

(As an appendix to the main article there is published a 2300 word report by Maj. Joseph Sailer, M.R.C., on the treatment of pneumonia in the base hospital at Camp Wheeler. The nature of this appendix is not such as to make it suitable for condensation. It should be consulted in the original.)

[A Consideration of the Causes and Prevention of Primary Pneumonias and Pneumonias Complicating Measles in the United States Army. By Capt. W. A. Pratt, M.R.C. *Military Surgeon*, June '18. 3000 words.]

(This article presents the writer's conclusions, based upon his experience in camp and post hospitals, concerning the causes that led to the prevalence of pneumonia in the army during the winter of 1917-18, and the steps that should be taken to prevent a repetition of the epidemics. The points are presented too briefly to permit of suitable condensation.)

POWDER

See also
EXPLOSIVES

—Smokeless

[Smokeless Rifle Powders. *Arms and Explosives*, Dec, '17. 3500 words.]

The earliest smokeless powder made for rifles was devised for use in military black-powder weapons. The smokeless powders which predated cordite were granulated mixtures of fibrous nitro-cellulose, metallic nitrates and slowing ingredients, bulked so as to make an approximate filling of the existing black powder cartridge cases. These powders were a failure, due to the nitrate of barium ingredient. The product of combustion of barium salts is barium carbonate, a hard granular substance of which a proportion always remains adhering to the walls of the barrel. In sporting powders the wads prevent accumulation, but with rifles the wedging of this substance against the bore by the bullet produces erosion which quickly removes the rifling from the breech end of the bore.

Colloidal powders burn in layers parallel to the original surface. This does not imply equal rates of burning thruout the substance of the grain for all qualities and compositions of powder, nor does it imply that an ascertained rate of burning is uniform for all grades of chamber pressure. The ingredients and the processes adopted in granulation vastly affect not only the rate of burning but variations of that rate under the influence of pressure.

Nitro-glycerine powder is a development of the principle of parallel burning. These powders are very stable, but the erosive effects are great unless a slowing or moderating substance is added. Nitro-glycerine powders are so severe on small arms and the smaller guns that no military power except England and Germany considers itself wealthy enough to adopt one.

Fibrous powders, altho belonging to the nitro-cellulose class, have given no trouble in the matter of stability; their products are harmful only when they remain imprisoned within the structure of the grain. Fibrous sporting powders contain plentiful means of egress, while in colloidal powders the products of decomposition are retained.

Pure nitro-cellulose powders exist in great variety, and are characterized by a very slow rate of burning thru the grain. The disadvantage of a small grain thickness is that the total charge aggregates a very large initial burning surface, thicker grains have a corresponding enhanced rate of burning, and may be attained by protecting the insoluble nitro-cellulose from the dissolving process. Another method of minimising the disadvantages of a large initial burning surface is to coat the grains with a relatively inert material.

As the erosion differences between the two classes of powder are understood and appreciated, the fact that the powders of the cordite class are always associated with the use of the wad is not accorded its full significance. If the wad were lacking the effects of barrel erosion would be greatly emphasized. The wad imposes very vital restrictions on cartridge manufacture since its diameter must materially exceed that of the bullet and it must be inserted before the mouth of the case is constructed.

Apart from the objections to loading rifle cartridges before the case has received its final shape, such as waste of powder when the case is defective, there is the fact that only a certain degree of shaping can be done. Cartridge cases having great neck reduction must be choked down in two stages, with an annealing process in between. No method can ever be devised for annealing the mouth of a rifle cartridge which has already been charged with powder.

Under certain conditions, a wad cannot be used, as for instance in cartridges containing a tracer or incendiary composition. This composition is ignited during the process of expulsion from the barrel, and the burning continues during the flight thru the air.

The influence of atmospheric as well as barrel temperature on pressure is considerable. After being heated by rapid fire, a barrel is capable of raising the temperature of a cartridge left some time in the chamber to a level for which atmospheric conditions can supply no parallel. Nitrocellulose powders not only show a lessened rate of accumulated barrel temperature, but the pressure responds much less than is the case with nitroglycerine powders to the stimulation so provided.

Intensity of muzzle flash is important from a mili-

POWDER—Continued

tary viewpoint, and the advantage here, as in all the other points of comparison, except stability, is with the nitrocellulose type.

[Granulation of Powder, with Reference to the wear of Guns. By Artemio Ferrario, Captain of Artillery. *Rivista di Artiglieria e Genio,* Dec, '17. 4500 words.]

The writer's intention is to consider how far it is desirable to reduce pressures by enlarging the grains of powder, having in mind both the wear on the gun and its accuracy of fire.

To get a given muzzle velocity, the area of the pressure curve must remain constant; hence if we reduce the chamber pressure we must increase that at the muzzle. The problem is not one of reducing pressures, but of distributing them.

Of two equivalent charges—*i.e.*, charges giving the same velocity—the quicker charge will be the lighter in weight, since the weight is a function of the initial combustion surface. A study of the pressure curves gives us all the necessary data for determining the behavior of different powders and their effect on the guns.

Guns of all classes have been subjected to extraordinary strains during the present war, and in general it seems that their life is greater than had been anticipated. Erosion, however, is as serious a problem as ever, since it has so marked an effect on accuracy.

Nobel's experiments indicated that the principal factor in erosion is heat. Noting that the energy communicated to the projectile depends upon rapidity of combustion, he concluded that the best system for reducing erosion was to reduce the proportion of nitroglycerine, compensating for the loss of energy by using a quicker powder, and thus increasing the maximum pressure.

Nobel also determined that the temperature increases materially with the density of loading. In general it may be said that the temperature depends upon the nature of the explosive, its chemical reactions, and the density of loading.

Erosion is greatest at the origin of the rifling, and then falls off, but increases again somewhat near the muzzle. Other conditions being equal, it increases with the charge, the caliber, and the weight of the projectile. According to Vieille, the erosion per unit weight of powder varies with the nature of the explosive, but not with the granulation. In his theory, it is chiefly due to escape of gas past the projectile. It increases with the pressure to a certain extent, but when pressures are very high it is practically independent of them.

The erosion near the muzzle is due to vibration, and also to the fact that recoil begins before the projectile leaves the bore, increasing the friction and wear.

Erosion falls off as the velocity of the projectile increases, owing to the diminution in the escape of gas and the increased volume available for expansion.

It results from the above considerations that it is desirable to use the quickest powder which is safe in the particular gun.

This appears even more clearly in considering accuracy of fire. The pressure curve has two branches, ascending to the point of maximum pressure and then descending. The ascending branch is affected by numerous causes not fully understood, but the descending branch is very nearly that of adiabatic expansion, and follows a well known physical law. It is evident that the movement of the projectile will tend to greater uniformity in this branch of the curve.

Incidentally, it may be noted here that dangerous wave pressures occur when the charge is very small and slow, and the density of loading low. Nobel found that where one charge gave pressures varying from 20 to 30 tons to the square inch in different parts of the chamber, another, developing the same muzzle velocity, gave pressures varying from 26 to 63 tons.

Such variations in pressure seem to have little effect upon the velocity of the projectile if the powder is all burned; but, of course, the effect is great if it is not. Another, and perhaps the principal, cause of variation, is the wear of the gun, which affects the seating of the projectile. Inaccuracy due to this cause is less with quick powder than with slow.

All considerations, then, indicate the use of the quickest powder that is permissible. For reduced charges, it is desirable to use a quicker powder than for full charges; this will give uniform velocities, and avoid danger of wave pressures.

PRACTICE MARCHES

See
Marches and marching

PRESS CENSORSHIP

Belgium

[The Press in Belgium. By André Loiseau. *Revue Militaire Suisse,* May, '18. 2600 words.]

La Libre Belgique is the principal organ of the clandestine press which is organized in Belgium to complete and rectify the incomplete or colored news which alone can appear in the newspapers authorized by the Germans. At the time the Germans occupied Brussels, most of the presses were destroyed by their owners, but soon after foreign newspapers began to circulate from hand to hand. It was no time for the Belgians to be without news. The Germans then perfected a system of excluding foreign papers, and a supervised press sprang up. The people soon learned not to believe this, hence the birth of the clandestine press. The government of occupation took care immediately to keep the people informed. It tried to do this by four kinds of publications: gratuitous serial publications and official placards, leaflets, certain Dutch papers favorable to the government imported from Holland, and local papers pretending to be Belgian.

The gratuitous papers were to inform the people of the military operations, but they were full of falsehoods. Thus the government of Berlin never spoke of the Battle of the Marne. A single allusion was made in a placard dated Berlin, Sept 14: "In the west operations have taken place, the details of which cannot be made public, a battle has taken place favorable to us. All news on this subject which presents the situation

as unfavorable to us is false." Inspired letters from friends, relatives, and business associates in Germany followed these up. German papers circulated in Belgium were specially prepared for their readers showing the discomfiture of the French. One day two sacks of the *Düsseldorfer General Anzeiger* of the same date came, one relating French disasters and one, intended for consumption by the people near the eastern front telling of Russian reverses. It was an error of the mail. Picture post cards freely mailed to persons in Belgium were ludicrous. One showed Uhlans looking at the Eiffel tower, another the storming of the fortress of Liège which in reality had no fortifications.

But patriots inaugurated a service of importation so that *Le Matin, Le Temps,* and various English papers were available at many fruit stands and small stores. Prices were high in proportion to the risk run, *The Times* sometimes selling for two hundred francs. Books such as Bedier's "German Crimes" were also brought across the frontier in vegetable baskets like the newspapers. But the greatest informer was *La Libre Belgique*. It came by various ways, one night in the letter box, the next by a friend. The authorities were powerless to stop it. The Germans must by this time be convinced of the fact that the Belgians cannot be conquered.

PRIMERS

[Primers for Explosive Grenades. By Antonio Garrido. *Memorial de Artilleria,* Jan, '18. 4800 words. 2 figures.]

(A discussion of the properties and advantages of certain primers manufactured as a result of the discovery of the detonating powers of the nitrate derivatives of some phenols and hydrocarbons of the aromatic series.

The author goes into the construction of fuses in some detail, giving dimensions, weights, qualities of material, etc., that should be used to insure a maximum detonating effect.

He gives 8 advantages of lead nitrates over the mercury fulminates.

The general properties of a good fulminate are also discussed.)

PRISONS, Military

—Transportation of Prisoners

[Transporting Prisoners. By Capt. V. M. Elmore, Infantry. *Infantry Jour.,* Aug, '18. 2300 words.]

The article is an outline, including the twenty-nine special orders for the guard on the train, of the method by which 120 general prisoners were safely transferred from Governor's Island to Fort Leavenworth in 1906. Any officer given a similar duty should have in his possession a copy of the contract for transportation in order that difficulties with the railroad authorities may be quickly settled.

The prisoners were handcuffed by twos, a short-term man and a long-term man. After entraining, the prisoners' shoes were removed and piled in one corner of the car. One sentinel was posted at each door, facing the prisoners. No windows were permitted open, and all lights kept burning brightly all night. In the event of any disorder, at the command "Attention," all prisoners were to sit upright with arms folded. Those not doing so were to be shot. All the orders for the guard were explained to the prisoners and no trouble was experienced while on the trip.

[Officers' Prisons in Germany. By "Captivus." *Journal of the Royal United Service Institution,* Aug, '18. 5000 words.]

In this interesting article a British officer recounts the experiences he underwent during his period of incarceration from the first part of the war in 1914. From these may be had some light on actual conditions as they existed in these prison camps. In all, he was confined at 4 separate prison camps, Crefeld, Schwarmstedt, Holzminden, and Freiburg, and discusses the treatment he received under the general heads of accommodation, behavior of the Germans, and food.

Accommodations.—At Crefeld, Holzminden and Freiburg, accommodations were practically the same, and comparable with those afforded British soldiers in times of peace. Field officers lived singly or in pairs, using sergeant's bunks, and junior officers had the equivalent of squad room accommodations. At Schwarmstedt conditions were much worse. Here, 360 officers were crowded into 3 huts 180 ft. long and 38 ft. wide, built of wood and covered with tarred paper. The site was a reclaimed swamp with pools of stagnant water, which made sanitary arrangements frightful.

For exercise the parade ground at Crefeld was used for football and recreation; at Schwarmstedt there were no facilities at all, and the one plot which might have been used for this purpose was devoted to a vegetable garden whose products were not for the consumption of the prisoners. They were, however, later allowed to construct a swimming pool in one of the ditches. At Holzminden the enclosure could easily have been altered to make it suitable for baseball which the Canadians desired, but their request to have it done only brought forth tirades of insults from Gen. von Hanisch, the Corps Commander under whom these camps were placed. He took the stand that they should all be shot, instead of pampered. At Freiburg the only place for exercise was a small court 50 x 30 yds. and surrounded on all four sides by buildings. As parole cards were seldom allowed the officers at this camp, the matter of physical exercise became important.

Treatment.—At the newly started prison camps the attitude of the Germans toward their prisoners was never the best. This was due largely to tales and extravaganzas which had been circulated about the character of the British, but this attitude improved on better acquaintance. At Crefeld and Freiburg very little difficulty was experienced on this account after Christmas, 1914. It was worse at Schwarmstedt and Holzminden, and at the latter place the behavior of the officers was especially contemptible, but better treatment was accorded the prisoners by the soldiers and non-commissioned officers.

At Crefeld in the early part of the war the Corps

PRISONS, Military—Continued

Commander, the famous von Bissing, did his best for the comfort of the officers. At Freiburg conditions were always better than the other places, even from the very start. Here the prisoners were in charge of Capt. von Bock of the regulars, and there was never .y occasion for complaint against him. He ran his camp well and treated his prisoners like gentlemen.

At Holzminden things were different. Here the commandant was a reserve officer named Niemeyer, who had also been in charge at Schwarmstedt. At both places he strained a point to make those under his charge as uncomfortable as possible. On one occasion this man attempted great effusion towards his Irish prisoners, but it was at the time when Germany was attempting to foment trouble between England and Ireland. Prisoners in German camps soon came to recognize the hypocrisy of German officers and by experience learned that they could never trust the word of a German officer in regard to any subject, no matter how trivial.

Food.—At Crefeld the prisoners were fed by a contractor until Aug, 1916. After that the messing was arranged by an International Committee of Officer Prisoners. After the change had been accomplished it was shown what enormous profits had been made by the contractor. There was a saving of 3000 marks the first month, and the rate dropped from 1.70 to 1.50 marks per day, and in addition there was a food surplus which was never the case under the old regime. Another advantage of the ararngement at Crefeld was that later the kitchen was entirely under the charge of the prisoners with not a German in it.

At Schwarmstedt the food was as poor as the accommodations. Here the prisoners were almost starved, and as the soldiers and prisoners drew from the same supplies, the prisoners' rations were invariably plundered. Moreover, everything was cooked by the Germans outside of the enclosure which facilitated this thievery. At Holzminden conditions were so much better that by contrast it was easily seen what impositions had been suffered at Schwarmstedt. At Freiburg messing conditions were best of all, but at all the camps the prisoners were practically dependent upon the parcels which were sent from home. These came with regularity from England, but the Russian officers had great difficulty with theirs.

Table appointments, such as knives, forks, spoons and crockery were not to be had at the camps of Schwarmstedt, Holzminden, and Freiburg, unless the prisoner purchased them himself. At Crefeld these were supplied by the messing contractor.

Canteens run in connection with the camps maintained a strict monopoly on all articles sold to prisoners and the most exorbitant prices were charged for everything sold. For example, at Holzminden a knife and fork cost 7 marks, and a spoon 2 marks. A clothes brush of common design cost 12 marks. The greatest gouge of all was the sale of drinking water at Schwarmstedt. Here the wells were two feet below the surface of the ground, so if one desired filtered drinking water he paid 10 pfennigs per glass for it. At Holzminden the officers were informed that they could have hot water for tea in the afternoons from 3 to 4 o'clock, and for this they were charged 1800 marks per month, which pro-rated about 3 marks per person.

It was also a common ruse for the Germans to sell articles to the prisoners and then take away from them the things which they had sold, or else deprive them of the use of the article. This was true of photographic supplies which were sold and then confiscated, of lamps which were to burn a special sort of oil, and then have the oil withheld. Another case happened at Bishofswerde where the officers were encouraged to organize a saber club. As soon as the sabers, masks and plastrons had been obtained, this diversion was prohibited and the equipment confiscated.

Fuel was quite a problem during the cold months. During the first two winters coal was supplied to be burned in the rooms of officers imprisoned at Crefeld. At Holzminden conditions were frightful. In spite of the bitter cold which set in as early as October, the fuel allowance was extremely meagre. Later on it was announced that officers would be allowed to purchase fuel at the rate of 25 marks per month, for which they received just sufficient fuel to have a fire for 3 hours per day in the living rooms.

At Schwarmstedt the officers were not permitted to send their laundry to be done outside of the prison, so they were forced to wash their clothes, as well as their persons at a pump in the court-yard enclosed in a small frame house.

Inasmuch as the ration had to be supplemented by parcels from home, the question of mails was a vital one to a prisoner in Germany. Strange to say, very little was ever lost en route, except for those parcels which were deliberately plundered by the German officials. At first letters came in 8 or 9 days from England. Later this length of time rose to over 45 days, and during 1917 parcels nearly always took 6 to 7 weeks. Of those parcels which had to pass thru the X Corps, the bread was invariably stolen.

Officers who leave Germany are allowed to take 25 kilos of heavy baggage with them, and have the rest sent after them at their own expense, or else stored in Germany until the end of the war. In traveling in Germany toward the latter part of the war, enemy officers were not insulted at the stations and stopping-places as at the beginning of the war.

As for reprisals, the Germans seemed to have the better arrangement for imposing reprisals upon their enemies. Instead of talking about what they were going to do, they would take a group of officers out and impose unpleasant measures upon them without telling them that they were in the nature of reprisals. Inasmuch as there was a mutual agreement between Germany and her adversaries that a notice of one month would be given before any reprisals would be exacted, Germany profited by the fact that it took from 3 to 4 weeks each way for the mails, and in the meantime they would be imposing the measures upon the unfortunate prisoners for 7 weeks, anyway, even if her demands were met. In one instance the French gave a German officer a ten-year sentence at

hard labor. The Germans gave ten French officers like sentences for one year. Both were later remitted. It all goes to show the crafty and designing nature of our enemy, the Hun.

PRISONERS (of War)

See also

EUROPEAN WAR—PRISONERS

PROPELLERS

See

AERONAUTICS—PROPELLERS

—Unexploded—Location of

See

ALPHA APPARATUS

RADIO COMMUNICATION

See

WIRELESS TELEGRAPHY

RAIDS

—Trench

See also

INFANTRY—TACTICS—COMBAT (Article: "Offensive Fighting")

RAILROADS

See also

WESTINGHOUSE FRICTION SHOCK ABSORBER

—Electric

[Electrical Railway, Pamplona-Aoiz-Sanguesa. By R. P. y P. de E. *Mem. de Ingenieros,* Feb, '18. 3000 words. 1 figure.]

(A discussion of the reasons for and against the adoption of different types of electrical railway equipment. Not of general interest.)

[Electrical Railway, Pamplona-Aoiz-Sanguesa. By R. P. y P. de E. *Mem. de Ingenieros,* Mar, '18. 4000 words. Figures and platees.]

(A discussion of the reasons for and against the adoption of different types of electrical railway equipment. Not of general interest. Concluded from February, 1918.)

[Electric Traction for Railways. By Capt. Enrique Paniagua. *Mem. de Ingenieros,* May, '18. 5000 words. (Concluded.)]

(A rather technical discussion of the advantages and disadvantages of electric traction for railways as compared with steam power. Not believed to be of general interest.)

—Hospital Trains

See

SANITARY SERVICE—TRANSPORTATION OF SICK AND WOUNDED—HOSPITAL TRAINS

—In Franco-Prussian War

See

FRANCO-PRUSSIAN WAR—RAILROADS IN

—Strategic

[Railway Systems from the Military Point of View. By Enrique Paniagua. *Mem. de Ingenieros,* Sept, '18. 5100 words. 2 figures.]

A state should require that its railways be so laid out as to provide not only for its commercial necessities but also for military purposes. Time is so important a factor in modern war that today a nation at war may suffer an incalculable loss in a very short time due to a faulty railway system.

In a country whose capital is situated close to the central district, the principal railway lines are clearly those radiating from the center towards the important coast and border points, as these are the arteries distributing the traffic, and also the veins collecting it. They have a place of first importance in military traffic, and especially in the first mobilization and concentration following the beginning of war.

An important corollary to these radiating lines is an efficient distributing system between them near their common junction, which will permit the rapid and uninterrupted movement of thru traffic and the proper delivery of traffic destined to stop near this point of contact of the different lines. The author here urges the advantage of a system of railway lines radiating from common centers and united at the junction points by a roughly circular line surrounding the city, with another line running across the center of the city. This keeps the congested railway yards out of the city itself and permits the thru traffic to be routed around the city itself.

Another point to be remembered in this connection is that with railroads, as with motor trucks, the shortest line of military communication is that which is shortest in time, regardless of the actual distances involved.

RANGE FINDING

See also

ANTI-AIRCRAFT ARTILLERY—RANGE FINDING
BALLISTICS
FIELD ARTILLERY—FIRE—AGAINST AIRCRAFT
FIELD ARTILLERY—FIRE CONTROL
FIELD ARTILLERY—RANGE FINDING

RAPID FIRE GUNS

See also

MACHINE GUNS

RECONNAISSANCE

See also

AERONAUTICS—RECONNAISSANCE BY

RECRUITING

See also

GREAT BRITAIN—ARMY—ORGANIZATION
MALINGERING

—Examination and Standards

[The Disposition of Patients and Candidates for Enlistment Who Present Symptoms and Signs of Heart Disease. By Maj. J. M. Swan, M.R.C. *Military Surgeon,* Feb, '18. 2700 words.]

During the present war the question of the interpretation of cardiac signs and symptoms has been so prominent that the British Medical Research Committee has devoted especial attention to the subject. A military hospital was set aside for the special study

RECRUITING—Continued

of these cases. This paper is based on the report of the staff of this hospital by Dr. Thomas Lewis, summarizing about 1000 cases which were given careful study.

(Symptoms of various forms of cardiac affections are briefly described and general rules are given for the separation of those cases which present signs of permanent disability from those which may be cured. Mention is made of methods of treatment for the latter class of cases. The article closes with a series of suggestions for the guidance of recruiting officers and ward surgeons.)

United States

[The Examination of Men of the First Draft Referred to the Cardio-Vascular Board, 89th Division, Camp Funston, Kansas. By Capt. J. L. Benjamin, M.R.C. *Military Surgeon,* July, '18. 2200 words. Illustration.]

(This article gives a description of the general system and the methods employed in examining cases referred to the special cardio-vascular examiners. The author also gives information concerning the various forms of cardiac lesions encountered, together with their relative frequencies.

The writer is of the opinion that the cardio-vascular and tuberculosis examiners should be closely associated. There is thus the greatest probability that undesirable soldiers will be eliminated early in their training. This is not only better for the efficiency of the organization but it is more just to the man.)

[A Report of the Physical Examination of Twenty Thousand Volunteers. By Maj. C. L. Cole, M.C., Capt. E. W. Loomis, M.R.C., and Lieut. E. A. Campbell, M.R.C. *Military Surgeon,* July, '18. 3500 words. 14 charts.]

(Conclusion)

(This is the final installment of the report on the examination of National Guard regiments upon their muster into the service of the United States. The authors sum up the results of their examination, illustrate the form of examination card used, and give a graphic expression of part of their findings by means of charts.

The report includes the examination of 13,584 men. Of these 4207, or 30.9 per cent, were accepted who had minor defects; 2101, or 15.4 per cent, were accepted with waiver of defect; 6236, or 45.9 per cent, had no observed defects; while 1040, or 7.6 per cent, were discharged because of physical defects.)

The authors come to the following conclusions:

1. Practically 50 per cent of all candidates volunteering for military service have physical defects which incapacitate them entirely or reduce efficiency.

2. The present method of examination requires acceptance of many defective men, or the rejection of many men who can be made capable of performing military service.

3. The establishment of refitting stations with properly organized staff for medical treatment and military drill would afford time for the observation of men before discharge and an opportunity for the treatment of curable defects.

4. The number of men available for military service would be increased.

5. The military efficiency of the forces would be increased thru bringing all men to a higher physical standard.

6. More efficient intensive training could be given at training camps, thru reducing the number of men who must be kept under treatment.

7. Many physical defects exist in young men of military age which could have been corrected by proper inspection and physical development while the individuals were school children.

RESERVES, Use of

See

TACTICS—GRAND TACTICS

RESPIRATORS

See also

ASPHYXIATING GASES

[German Poison Gas Harmless against Masks Worn by U. S. Troops. *Official Bulletin,* Oct 30, '18. 10000 words.]

The Germans have been making a particularly heavy use of gas against American troops in Lorraine. They have been bombarded unceasingly with mustard and other gases. The chemical warfare service has provided efficient protection against this form of attack.

The American masks give 20 times the protection afforded by the German masks. No American soldier protected by a mask has fallen victim to gas. Many officers assert that a man who is gassed ought to be court-martialed instead of decorated.

All are trained in the use of masks, which are put on in five motions of the arms and hands. No man is taken to the front line who cannot adjust his mask in six seconds. Recently a company established a record of donning masks in four seconds.

The British recently put 70 tons of phosgene into the air at once, with consequences known to the German General Staff.

The American masks defy any degree of concentration of gas. They were developed experimentally with full data respecting the French and British masks, and we have the best mask on the western front.

The first 200,000 Americans in France were supplied with British masks. Some of the units brigaded with the British recently have also used British masks as a matter of convenience, because all their supplies came from British sources. Prior to the July, 1918, counter-offensive there were American gas masks sufficient for all American soldiers in France, with an ample reserve.

A gas mask is decidedly uncomfortable, but one can soon get accustomed to it. It fits over the head like a catcher's mask. The nostrils are closed by a clip. The breath is drawn in thru the mouth thru a tube connected with a canister of chemicals which extract the poison gas. The breath is exhaled thru a flutter valve near the chin.

Men can wear masks while indulging in practically any form of activity. They have even worn them while playing baseball. In action, the masks have repeatedly been worn for 12 hours at a stretch.

Absolute immunity from German gas is merely a matter of training. A few cases of gassing will occur accidentally, but most are due to carelessness.

REWARDS, Military

See

DECORATIONS AND REWARDS, MILITARY

RIFLES AND RIFLE SHOOTING

See

INFANTRY—ARMS—RIFLE

RIGA, Capture of

[The Operations in Livonia. By Maj. Luis Ruiz de Valdivia. *La Guerra y su Preparación,* Nov, '17. 1700 words. 1 map.]

Livonia is bounded on the north by the province of Esthonia, on the south by the Dvina River, on the west by the bay of Riga, on the east by the provinces of Pskov, Petrograd and Witebsk. The northwestern part of the country is almost covered by lakes, while the southeastern section is mountainous and covered with forests. Eighteen and five-tenths per cent of the land is cultivated, 41.5 per cent is used for pasturage, 24.4 is in forests, and the rest is covered by lakes.

Livonia is essentially a cattle country, tho some oats, rye, and potatoes are produced. The chief manufactures are alcoholics.

Riga, with 400,000 inhabitants, is the largest city of Livonia. Before the war the total population of the province, including the island of Oesel, was about one and two-thirds millions, of which 5 per cent were Germans, 3 per cent Russians and the rest Letons and Estons. Railroad lines in Livonia are scarce. Besides the Riga-Dünaburg line there is only the Riga-Dorpat-Tags line. Roads and highways are few and ill kept.

After the conquest of Courland in 1915, the Germans established their line on the Aa and Dvina rivers. Later they moved back to the Tirul-Sumpf and the Russians took the Aa River line, which resulted in extending their bridge-head at Riga. This bridge-head with its various supplementary works extended over a radius of between 20 and 30 kilometers and was a constant menace to the German left wing. It would have permitted the Russians to launch large numbers of troops on the German lines in Lithuania and Courland from Petrograd. This would have rolled these lines back.

For this reason the German high command decided that the occupation of Riga was a necessity. The operation was not carried out until later because no propitious moment had offered itself, and all preparations had not been made. As a frontal attack on Riga, with its twenty defensive lines, strong flank positions, and its completely equipped defensive line from Olai to the Mitau woods, was impracticable, the Germans had to select another point of assault.

At the beginning of the German offense the Russian garrison of Riga consisted of the 2nd, 6th and 43rd army corps, one brigade ("Lettishbrigade," about the size of a division) and one cavalry division. Behind the Dvina was the 21st army corps, another division and two brigades (Lettish brigades). The total Russian force was 15 infantry divisions and one cavalry division, in all, about 150,000 men.

The German preparations for the attack caused the Russians to shorten their bridge-head line, and to move back on the Aa River as they supposed that the German attack would be along the Ekkau-Kekkau road, where the Teutons had constructed strong positions. The Russian General Staff knew that an attack was to be made, but the date and place of this attack were unknown. The Russian staff considered the crossing of the Dvina River at Uxkull an impossibility, as the stream is 300 meters wide.

Taking advantage of the favorable terrain in that vicinity, and under cover from the Russian observers, the Germans concentrated their attacking divisions in the woods near Uxkull and close to the river. After reinforcing their positions on the edge of the river with plenty of artillery and heavy mine-throwers, the Germans decided to attack on Sept 1.

The operations were to be in three phases. 1st, the tactical rupture of the Russian front near Uxkull; 2nd, the advance along the length of the Mitau-Riga road against the bridge-head of Riga; 3rd, the breaking of the Russian front south of the road and railroad which, on crossing the Wenden Walk, join Riga to Petrograd. It is evident that if the Dvina was forced at Uxkull, the Riga bridge-head could then be taken in reverse, and the frontal attack made at a smaller cost in lives, and more easily carried out.

The artillery and bomb-throwers opposite Uxkull opened the attack at 1:00 a. m. Sept 1, the attacking batteries being in position between Dunahof and Borkowitz. Under the protection of the artillery, and after three hours of destructive fire and two hours of gas pontons had been previously moved by hand to the edge of the river, where they were covered with branches. The first forces carried pontons across the river and immediately started to build three bridges. (Positions marked on map.) Four hours later three divisions started across the three bridges. With the right river bank occupied, and the Russian positions secured, the Germans immediately built a bridge-head, which extended as far as the Little Jägel River. This bridge-head was held against the Russian attacks from the direction of Riga and Kennewadel, and at the same time protected the passage of the remaining German forces.

The troops which crossed the Dvina were divided into three groups, and a different objective was assigned to each group. One group, commanded by General Kathen, with its front towards the southeast, had as its mission the protection of the flanks of the other two groups, besides the halting of the Russian reserves which were advancing from Dünaburg. Another group under General Berrer, which constituted the "Stosstruppen" and which was supposed to gain

RIGA—Continued

the main decision, marched to the north towards the Riga-Wendel road. The third group under General Riemann had as its object the advance to the southwest, that is towards Riga.

On the morning of the 2nd the Russian positions in front of Berrer's group had been broken, and in the afternoon he reached the Big Jägel river and brought the Riga-Petrograd railroad under the fire of his artillery. From this time on the fate of Riga was sealed. When the Russians realized the mainitude and importance of the crossing of the Dvina, they withdrew their divisions from the Riga bridge-head with all speed. The Germans occupied the suborbs of the city, on the left river bank, the afternoon of the 2nd, and entered the city the morning of the 3rd. Finally on the 4th the resistance of the Russians against Riemann's group, near Kulpe, was overcome, the Germans reaching the road east of Hinzenberg, and their cavalry pursuing the enemy in the direction of the Aa river. Kathen's group forced the Russian reserves from Dünaburg to retreat.

Dunamunde was abandoned by the Russians on the 3rd, after burning all storehouses and destroying all the seacoast batteries which were of old models. It was occupied on the morning of the 4th by a German detachment which marched overland, and another which came by water from Mitau. Troops were later moved by water up the Aa river and ended the operations with the capture of Jacobstadt on the 22nd. After a tenacious resistance by the Russians in the bridge-head which had been constructed around this town, it was finally taken by troops under General von Schmetton.

The results obtained in this offensive were chiefly due to the sureness with which the German General Staff directed the operations, to the artillery preparations, and especially that of the large-calibered bomb-throwers, whose moral and material effect is each day increasing. Finally, success was due in a great measure to the deficient condition of the Russian army. For this reason only were the Germans able to occupy Riga so easily and without heavy casualties.

RIGA, Gulf of

See

EUROPEAN WAR—GENERAL NOTES ON OPERATIONS, BY THEATERS—NAVAL OPERATIONS

RIVER CROSSINGS

See also

BRIDGES, MILITARY
PONTON BRIDGES

[Tactics and Technique of River Crossings. By Colonel Mertens, Chief of Section in the Engineer Committee, Germany Army. Translated by Major Walter Krueger, U.S.A. x+253 pages, 4 maps, 105 figures, 6x9 in. *D. Van Nostrand Company,* 25 Park Place, New York City. Price $2.50 net.]

Military history presents many instances where the success or failure of an operation, and even of a whole campaign, has depended upon the crossing or the defense of a river line. There is little doubt that in future, too, these matters may provide the commander with some of his most complex and difficult problems. It is essential, therefore, that all officers should have a thoro understanding of the subject, in order that the ever present difficulties may be met as effectively as possible.

Colonel Mertens' work offers to the military student a thoroly comprehensive, authoritative and modern treatment of this important subject. That the work of translation is ably done is assured by the fact that the translator is Major Walter Krueger, already so well known thru his translations of Balck's Tactics. The present book is distinctly readable, in addition to being of professional value to the army officer. The manner of presentation of the subject is not technical, the book being intended for the use of officers of all branches.

In his general remarks at the beginning of his treatise, the author urges strongly the extreme importance of the most complete mutual understanding and the fullest co-operation between all the arms concerned. One of the most difficult parts of bridge construction in war is the harmonizing of the technical and the tactical requirements. "When strong hostile opposition may be expected, tactical and technical work must go hand in hand in order that the probably very difficult task may be executed with certainty and despatch. . . . But tactical measures that are not consonant with technical requirements and possibilities may be just as disastrous as technical plans that do not meet tactical demands."

The subject of "River Crossings" is discussed under four headings: I. Bridge Construction Outside the Effective Zone of Strong Hostile Forces. II. Accelerated Crossings in the Immediate Presence of the Enemy. III. Forced Crossings. IV. Surprise Crossings.

"Defense Against a Hostile Crossing" is considered, after a preliminary discussion of "Kinds of River Defense," under three heads: I. Position of the Main Forces at the River (Cordon system). II. Defense of a River Line with Small Detachments Posted on the Bank. III. Rear Guard Actions on River Lines.

Each of the foregoing classes of operations is illustrated by examples taken from military history or from grand maneuvers. There then follow, as further illustrating and exemplifying the principles enunciated, two very interesting tactical studies involving the attack and defense of river lines.

The book has two valuable appendices. Appendix I discusses at length "Expedients for Quickly Crossing Streams," subdivided into "Fording and Swimming," "Rafts" and "Hasty Bridges." The treatment of the last subhead is especially good; numerous ingenious expedients are given briefly but clearly. Appendix II contains information on the bridge trains of the armies of Germany, England, France, Italy, Austria-Hungary and Russia.

—In European War

[Examples of Passages of Rivers. By Ruiz de Valdivia. *La Guerra y su Preparación,* Aug, '18. 4000 words. Photos. Maps.]

Meuse, 1914

The river has a depth of three and a width of 80 meters.

After the victories about Neuf Château, the 4th Army, under the Duke of Württemburg, marched on the sector Mézières-Sedan. The Crown Prince with the 5th Army, after having occupied Longwy and Montmédy, advanced on the sector Stenay-Verdun. The French organized their defense on the left bank. Despite the natural advantages of their position and their desperate defense, the German artillery prepared the way for the infantry and pontons. The passage was forced Aug 31, the 4th Army crossing at Donchéry and Remilly, and the 5th at Dun.

Vistula, 1915

The Vistula's average depth is three meters, its width three hundred.

To force the Russians to give up their lines along the Vistula and the Narew, Mackensen determined to force the Vistula and strike at the Russian communications. The bridge heads were strongly held and the Russians believed the river to be impassable. The place chosen for the passage was midway between Warsaw and Ivangorod, where the Germans' banks were heavily wooded and marshy, and the Russians' backed by sand-dunes. König, who was to force the passage, used the Radomka, perpendicular to the Vistula, as his base, collected ponton matériel in secrecy, and prepared artillery positions in the thickets along the banks.

With Kövöss covering Ivangorod and a cavalry division Warsaw, König advanced on the night 27-28 July in ten columns on a 15 kilometer front. At dawn on the 28th, under cover of heavy bombardment, the crossing was effected, the dunes taken, and a bridge head organized. The whole Russian line was forced to fall back.

Narew, 1915

This river has an average width of 100 meters.

Its bridge heads at Lomza, Ostrolenka, Rozan and Pultusk were well fortified, and the Russians had in addition a strong series of fieldworks. Gallwitz and Scholtz so demoralized their outlying posts that they retired into their bridge heads and abandoned their intermediate works. The Germans improvised bridges and crossed at many points. Lomza fell Aug 10 and Novogeorgievsk the 20th.

Danube, 1916

The average width is 1600 meters. The southern heights dominate the northern banks which are marshy plains. At what is known as the Iron Gate the river narrows down to 200 meters, flowing with swift current between high cliffs.

Serbia foresaw a crossing at this point and massed to meet it. Mackensen did actually feint at this point with a small force.

One crossing was then forced at Bazias, Oct 6, after a three-hour bombardment. Another one at Temes Island was made, but this was delayed badly by a storm. A third at Semendria was made possible by artillery fire. Gallwitz commanded the Bazias-Semendria sector. Kövöss crossed at Belgrade and took it on the 11th.

On another occasion Mackensen crossed at Sistova into Rumania. He feinted with part of his heavy artillery at Rustschuk, Widin and Tutracan. Making all preparations with great secrecy, he attacked at Sistova Nov 24, 1916, cleared the banks by artillery, and aided by gunboats, crossed in boats. That same night he threw two bridges across the stream. Here, the river is 900 meters wide.

[The Serbian Campaign of 1915 and the Rumanian Campaign of 1916. By Col. Antonio Mayandia. *La Guerra y su Preparación*, May, '18. 20,000 words. Cuts. Photographs. Maps.]

Passage of the Danube and Save Rivers by Austro-Hungarian and German Troops, Capture of Belgrade. Oct 6 to 13 1915

In July, 1914, there had been collected at Budapest enough material for a 1000 m. linear bridge, which was to be constructed in 11 meter bays placed on lighters such as are commonly used on the Danube and which have a capacity of 500 metric tons. This material was collected for any eventuality that might occur.

The Austrian Army had material for a similar bridge in storage at Ujoidek.

At Semlin the Austrians had collected four transports each capable of holding one battalion of 1000 men or a war strength field battery.

At the proper time, the Austrians transported by rail to a point 13 kms. above stream from Semlin, 24 complete units of the perfected Birago bridge material. Each one of these units contained material for a 35-meter bridge. Besides these units, which were manned by 30 ponton companies, 300 separate ponton pieces were transported to the same place at the same time.

From this Austrian material four complete units, 150 ponton pieces, and two of the above mentioned ponton companies, were assigned to German technical troops which were to force a crossing of the Save simultaneously with the Austrian crossing of the Danube.

The other six companies were distributed as follows:

Three companies of four units each to form the advance force (20 ponton pieces at Semlin, one at Kozara).

Two companies in support with remainder of ponton pieces at Uj Borresa.

One company in reserve at Belanga.

The Austro-Hungarian forces organized three flotillas of 12 large pontons to carry a landing party to the Serbian side of the river. The flotilla carried 320 men. The first two flotillas to make landing were reenforced by four boats carrying 60 men each and towed by motor launches.

The Night of Oct 6 and 7, 1915

The flotillas leaving Semlin and from the bend in the river formed by the Island of Kozara were to attack Belgrade as follows:

RIVER CROSSINGS—Continued

The first flotilla of the advance was to land opposite the large island of Krieg. To facilitate this landing a wooden building near the shore was to be set afire. The 2d and 3d flotillas were to land down stream from the 1st flotilla. The 2d flotilla took so long to get across the stream that this personnel was practically annihilated, and certainly it was of no material assistance. The 3d flotilla was massed by the island of Kozara and landed its personnel opposite the slaughter house according to previous arrangements. In the 1st flotilla of support, all the motor launches were sunk by gun fire, forcing the occupants to row part of the way across the river. Operations were suspended by dawn of the 7th, before some 3000 infantry men had effected a crossing.

Day of the 7th

Under cover of the island of Kozara, 48,000 pontons of second and third pieces were prepared for bridge work.

Night of Oct 7 and 8

The flotillas continued to carry across infantry. This battalion with machine guns was transported across the river, and part of it went into action on the Serbian shore. At the same time ammunition supplies were moved across by the flotilla. The total of men on the Serbian shore reached 6000.

On the Morning of the 8th

Oct 8, nothing could be done during the day time because of the very effective enemy artillery fire.

Night of Oct 8 and 9

The flotilla carried across between ten and twelve infantry battalions with their machine guns. At dawn, Oct 9, the passage of artillery batteries commenced. For this purpose twelve barges built of four pontons each were used. These barges were towed by six stern wheel tug-boats. The infantry continued to pass until 12 o'clock.

On the afternoon of the same day, a ponton bridge was thrown across the Save River. This bridge was finished about 9 or 10 o'clock that night.

Day of the 10th

The infantry started to cross the river by way of a ponton bridge, the artillery continued to be towed across from Semlin above stream from the railroad station.

Day of the 11th

The infantry continued to pass over the ponton bridge. The Germans constructed two bridges for the use of the 22d corps. These bridges were built between Gypsy Island and the two shores of the Save River. One of these bridges was completed on the 11th. This one was built entirely of Austrian material. The second bridge was built half with German regulation material and half with captured Serbian material. The length of the bridge was 380 meters.

Day of the 12th

Infantry continued to cross.

ROADS, Military

[Military Highways. By L. W. Page. *Jour. Franklin Institute*, May, '18. 5700 words.]

Highways play an important part in the conduct of modern war. France was practically saved by her ever-ready system of roads, and the great number of motor busses which quickly conveyed her troops to the point of attack. We must not, however, lose sight of the fact that the system of roads as now completed at the French fighting front was not complete, in the present sense, at the beginning of the war. The present system consists in considerable part of extensions to the main arteries which had been built years ago according to a program having the civil as well as the military needs of the country as a basis of design.

This is the only basis upon which any comprehensive system of highways can be designed. The scheme must be based upon the civil as well as the military problems involved. The underlying principle of road location in a large area is to provide first the large open net of thru roads that will serve as a framework for the entire road system. This will then be elaborated to such an extent as the local conditions may justify. The areas most liable to attack should, of course, be developed first. In some localities an elaboration of the road net beyond that required by the civil needs will probably be justified. In practically no case will the construction of so close a network as is required by modern battle conditions be warranted before the outbreak of hostilities. This ultimate development of the peace-time road system must be left until the actual theater of operations has been fixed.

The details of location and design must also depend very largely upon the same considerations which control purely civil highway construction. The density of traffic under peace conditions can never equal that flowing from the demands of war under some circumstances. For example, the Verdun-Bar-le-Duc road in France, about 50 miles in length, was forced to carry, during the months of the attack upon Verdun, a continuous line of motor trucks thruout the day and night. Traffic moved in four lines, the speed of the vehicles varying with the line in which they moved. It is impossible to tell in advance what roads may be called upon to withstand such a traffic as this, while any attempt to meet the possible military demands on all the roads would result in the economic breakdown of the whole highway policy. The roads must, therefore. be justment of some of the engineering considerations that designed upon their civil requirements. A slight adenter into ordinary highway construction should be made. Grades should not exceed five per cent, except that an emergency maximum up to ten per cent for not more than fifty yards may be allowed. Alignment should have no curves with less than two hundred feet radius, and a vista of not less than three hundred feet. The road foundations and bridge structures should be designed and built to carry at least 6000 pounds forward and 8000 pounds behind, on a wheel base ten by five feet. The paved surface should be twenty feet wide and the grade thirty.

Roads built as the immediate accessories of an advance must be of materials that consolidate and furnish a traveled way in the least time. Such roads will probably be found in water-bound macadam and gravel. Likewise the repair of these roads, so long as they remain a part of the battle area, will have to continue of this type, or perhaps, under some conditions, of cold patch materials. The requirement of maintenance controls under actual fighting conditions. Repairs must be made easily, rapidly, and without in the least interrupting or diverting traffic. In time of peace a road of this character is not always economical in many localities. It may be desirable, therefore, to select a type of construction better fitted to the peace time requirements, subject to not too difficult repair in emergency.

(The writer proceeds to discuss a possible road system for the United States, based upon the conditions stated.)

ROYAL FLYING CORPS

See
AERONAUTICS—GREAT BRITAIN

RUMPLER BIPLANE

[The Model C. IV Rumpler Biplane. *Aviation*, Mar 15, '18. 1180 words. Illustrated.]

The Model C. IV Rumpler biplane belongs to the so-called "all-purposes," or general utility class of enemy machines, which may be employed for scouting, offensive patrol, bombing, etc. The climbing speed of the Rumpler C. IV is 5000 m. in 35 minutes.

Span, upper plane	12.60 m.
Span, lower plane	12.10 m.
Overall length	8.40 m.
Overall height	3.35 m.
Weight, net	1010 kg.

Both the upper and the lower wings have a retreat of 3 deg. and a dihedral of 2 deg. The upper wings are of trapezoidal shape, with rounded corners, and are cut out for visibility above the body. The maximum chord is 1.70 m. and the interplane gap, which is uniform, is 1.85 m. The lower wings have rounded tips, such as are found on many German machines, the D.F.W., for instance, and have a certain resemblance to the blade of an airscrew, because the radius of the arc forming the trailing edge is greater than that of the leading edge.

There are two pairs of interplane struts on either side of the body. These are slightly inclined and strictly parallel to one another. The total surface area is 33.5 sq. m., of which the upper wing carries 20 sq. m., and the lower wing, 13.5 sq. m.

The tail planes consist of horizontal and vertical fins, elevator, and rudder. The horizontal fin, which is not adjustable, has a much smaller chord than is found on preceding types. The vertical fin is of triangular shape. The rudder is of the non-balanced type, and is 1.20 m. high, and 0.61 m. wide. The structure of all the tail planes is built up of steel tubing. The control cables are entirely carried within the body; to prevent jamming, the cables are partly led thru small wooden tubes.

The body is of rectangular cross-section, and is built up, in the current way, of four longerons and a number of cross-pieces braced by wire stays. The power plant of the Rumpler C. IV consists of either a 260 h.p. Mercédès engine, or a 250 h.p. Maybach of the type currently employed on Zeppelin airships. The engine is fed from two fuel tanks. The main tank, holding about 220 litres, is mounted beneath the pilot's seat; the second, service tank, holds about 70 litres and is placed between the pilot's seat and the after seat. Behind the engine there is the pilot cockpit, behind which is the cockpit of the gunner. The pilot cockpit contains a bomb rack of the self-feeding type. This rack holds four bombs. An opening is provided in the floor for taking photographs. A radio set is also installed in the machine.

The undercarriage is of the usual V-type, with a rubber spring axle. Contrary to the usual German practice, no brake is fitted to the undercarriage. A drift wire runs from the front end of the body, on either side, to the lower base of the inner front interplane strut. Another drift wire runs from the upper base of the same struts to the base of the forward undercarriage struts.

RUMANIA

—Army—Schools and Training

[The Engineering and Artillery School of Rumania. By Lt.-Col. Arturo Sola. *La Guerra y su Preparación*, Nov, '17. 1200 words.]

This is a school for reserve officers, located at Jassy in the old quarters of the 7th Regt. of Cavalry. The place is admirably adapted for a school of this sort.

The director of the school is a colonel; he has 14 assistant professors who are captains and lieutenants, three of whom are engineer officers. One French major of artillery is attached to the school.

Pupils are recruited from among the graduates of military schools, and others who can pass the entrance examinations.

The school consists of about 750 cadets who are organized into two batteries of artillery and one company of engineers.

The military course consists of enough theory to make each man understand his particular work, and practice in the same.

The course lasts 6 months, after which the graduates of the artillery school are sent to their regiments for an additional month's training before they receive the grade of 2nd lieutenant. The engineer graduates are commissioned immediately after a month of field training.

A second class of 300 men followed by a third class of 500 men has recently been admitted to the school.

If after the war, any graduates of this school desire to enter the active army they will be required to do additional study on technical subjects.

According to Colonel Bolter, director of the school, the graduates leave with an excellent preparation for their active duties; and animated by a great enthusiasm, but well subjected to discipline.

RUSSIA

—History

See also
EUROPEAN WAR
RUSSO-JAPANESE WAR

[Revolution and Discipline: The Gap in the Entente, 1917. By T. Miller Maguire. *United Service Mag.*, Nov, '17. 5500 words.]

(A discussion of the Russian revolution and its effects both internal and upon the strategy of the Entente Powers. By citations from history and from the expressed opinions of famous leaders the world over, the author shows that "without military force no revolution has succeeded in any age, and without discipline no military force has been of any service.")

[The Revolution in Petrograd. By D. Protopopov. *Naval Review* (Russian), July, '17. 10,500 words.]

(This is a very interesting article descriptive of events in Petrograd at the beginning of the Russian revolution in March of last year by a writer who apparently was a participant in the scenes of which he writes.)

The revolution started unexpectedly on the morning of Mar 11, and was the result of the hunger of those who first took part in the demonstrations. At the commencement only workmen were involved in the disturbances and street gatherings. On this same date the emperor Nicholas undertook to dissolve by telegraphic orders the Duma, then sitting in Petrograd, but the Duma replied promptly by wire, refusing to leave their posts. Firing in the streets started later this date.

On Mar 12, about 25,000 soldiers of the Volynsky, Preobranshensky, Litovsky and other regiments, some with their officers and some without, joined the manifestants, and seized the arsenal and the Petropavlosk fortress. A deputation of soldiers was sent to the Duma for information, and these were informed by Mr. Rodzianko, president of the Duma, that the legislative body would assume responsibility and would maintain order. An executive committee of the Duma, under its president, was formed early on the evening of this day.

On Mar 13, a last appeal was sent to the emperor to come to the assistance of his people. On this date there were also numerous collisions between the people and the police force, much rifle and machine gun firing taking place. Additional troops passed over to the side of the people, and the congress of Soldiers and Workmen's Delegates, of which we have since heard much, began to take an active part in affairs by arresting ministers of state and dictating to the Duma. In all these disturbances no special leader appears; rather what took place were the disconcerted actions of mobs of soldiers and workmen without work, for lack of materials, due to a breakdown of transportation systems, and without food for themselves and families. These uneducated masses had reasoned out for themselves that the Government was responsible for the condition of things and with blind fury proceeded to arrest and confine the heads of all government departments, with the hope that with their disappearance work and food for all would automatically appear. How disappointed the expectations of these first revolutionists must have been in subsequent months.

On Mar 14 a new ministry was formed to administer the government provisionally. Most of the remaining troops in and around Petrograd, who had not as yet joined the new movement, did so on this date, and many officers of the army, casually in the city, made their submission and definitely ranged themselves on the side of the revolution.

On Mar 15 a new provisional ministry was organized with Prince Lvov as its president. Mr. Rodzinako retained his position as president of the Duma. Mr. Kerensky appeared as a minor member of this ministry, having previous to this time been a member of the Duma. This day a telegram was received from the Grand Duke Nicholas, commanding the armies in the Caucasus, wishing the new government success.

On Mar 16 the Grand Duke Michael gave his submission to the new government, and this government felt so much encouraged that they sent radio messages, addressed to "Everybody, everywhere," announcing the new order of things.

On the following two days additional adherents to the new cause were received, and expressions of confidence and good will arrived by telegraph from troops at the front, and from many parts of the Russian empire. It would appear that the old Imperial government had but few friends for itself.

On Mar 18, the Workmen's and Soldier's Delegates issued their second general order. This order, No. 2, directed the election of representatives in each miliary unit to represent them at Petrograd. This order was the first of many succeeding ones that have resulted in the destruction of discipline in the Russian army. Some other orders of less importance were issued on succeeding days, and a perusal of these indicates clearly that the need of food was in many cases a prime consideration for the issuing of the order.

(This article which does not go further in this number of the magazine, illustrates the necessity in time of war of giving great attention to economic questions. An apparent failure to provide for their own people at home led to the Russian revolution, with its important effect on the present great war. Whether it was possible for the Imperial government to have foreseen the arising storm and to have either avoided it or made suitable provision for passing thru it yet remains to be seen.)

[Military Aspects of Revolution. By Major T. E. Compton. *United Service Mag.*, Apr, '18. 400 words.]

(A comparison of some of the aspects of the Russian revolution with those of the French Revolution. The distinguishing feature of the Russian revolution is the peace-at-any-price spirit of this remarkable upheaval. Discipline and the army have gone to the winds, with

the clever connivance of the Germans, who sent them Lenine and a few other anarchists to help along.

In the French Revolution there was a general breaking down of discipline in the army, but under stress discipline re-asserted itself.)

—Military Topography of

See also

CLIMATE, MILITARY ASPECTS OF

—Navy

[Preparation of Naval Officers. By A. Polidorov. *Naval Review* (*Russian*). Aug, '17. 700 words.]

(This is a short article stating that many young officers in the Russian naval service had made good as a result of a short course of training of only three months. This training course is described as covering the following subjects:

a. Astronomy, theoretical and practical;
b. Navigation, theoretical and practical;
c. Deviation of the compass, theoretical with practical exercises;
d. Electricity, short review;
e. Ship construction, short review;
f. Radio telegraphy, theoretical with practical exercises;
g. Physical geography;
I. Miscellaneous.)

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[Reforming of the Admiralty Staff. By M. Kasimirov. *Naval Review* (*Russian*). Aug, '17. 2000 words.]

With the breaking up of the old Russian Imperial government, a general change was made in Russian methods of administration, and among others the Imperial Navy was reorganized. By General Orders No. 265, dated at Petrograd July 1 (14), 1917, a new Admiralty Staff was organized composed largely of sailors and workmen from the various fleets. The Minister of the Navy is the presiding officer of this staff or council, and is assisted by a Secretary, to whose office all communications intended to be brought before the council are sent. The Secretary is bound to place these communications before the council at as early a date as practicable.

The Staff is charged with considering all matters relating to organization, supply, new construction, discipline, etc.

RUSSO-JAPANESE WAR

See also

TACTICS—GRAND TACTICS (Article: "Use of the General Reserve in the Russo-Japanese War")

—Naval Operations

[The Naval Campaign of 1904. By Editorial Committee. *Naval Review* (*Russian*). July and Aug, '17. 20.000 words.]

This is a long article giving a detailed account of the voyage of the Russian fleet from Russia to Japanese waters in 1904-1905, and the subsequent battle of Tsu Shima. The article does not admit of condensation. While historical in character, the author fails to state the source of his material for his account, and the value of the article from a historical standpoint is therefore doubtful.

S. V. A. AIRPLANE

[The S. V. A. Fighting Plane. *Aerial Age Weekly*, Dec 3, '17. 900 words. Illustrated.]

The S. V. A. machine has the interplane strut bracing, at either side of the body, arranged in the form of the letter N. All the materials used in the construction of these machines is tested in laboratories before being installed and is again rigidly inspected when the machine has been tested out in flight. The silk linen covering is slightly transparent, and after being treated with dope is practically untearable. The dimensions are: span upper plane, 30 ft.; span lower plane, 25 ft.; chord, 5.5 ft.; length, 26 ft.; height, 10 ft.; weight empty, 1411 lbs.; motor, S. P. A., 210 h.p.; speed range, 45 to 125 mi. per hr.; climb, 4000 ft. in 14 min. The planes are in four sections. As in most of the fast Italian machines, the trailing edge is flexible, tending to flatten out the wing curve as the speed of the machine increases. A single set of ailerons is hinged to the upper plane. The steel tube interplane bracing is of streamline section, and attachment to the spar is by a pin running thru the end of the brace, parallel to the line of flight. Main planes have a surface of about 24.25 sq. m. A noticeable feature of the fuselage is its narrow end at the tail and its exceptional depth forward. The leading edge of the tail plane is located at the level of the center of propeller thrust. The familiar triangle fin is used, with the rudder hinged to its trailing edge. Control wires run into the body thru protective metallic plates with friction reducing guides. The tail skid is unusual inasmuch as it relies upon a steel leaf spring skid for its shock absorbing effect. The engine is a 6 cylinder S. P. A. developing 210 h.p. at 1600 r.p.m. The propeller is 9 ft. in diameter with a 7 ft. pitch. Gasoline is carried for an endurance of 3 hours.

SALONIKA

See

EUROPEAN WAR—GENERAL NOTES ON OPERATIONS BY THEATERS—SOUTHEASTERN THEATER—MACEDONIA
EUROPEAN WAR—GENERAL NOTES ON OPERATIONS—SOUTHEASTERN THEATER — SERBIAN-SALONIKA FRONT

SANITARY SERVICE

See also

AERONAUTICS—MEDICAL ASPECTS OF
BATH TRAINS
DISEASES
HOSPITALS
LIBRARIES, MEDICAL
PNEUMONIA
SURGERY, MILITARY
WOUNDS

—Bacteriology

[A Study of the Aerobic Bacteria Found in Wounds Received on the Battlefield of the Somme. By Lt.

SANITARY SERVICE—Continued

J. S. Lawrence, M.R.C. *Military Surgeon,* Feb, '18. 2200 words]

(The purpose of this paper is to give to the American surgeon and bacteriologist an idea of the types of organisms that contaminate gunshot wounds on the western front, their relative frequency and importance, and simple methods for their identification. It is based on material collected during the summer of 1916 about Peronne at the time of the British and French offensive.

The article presents a brief survey of the sources of contamination, the methods employed in a base hospital laboratory, the types of aerobic organisms encountered, and their significance to the surgeon.)

—Camp Hygiene

[Sanitation in War. By Col. T. H. Goodwin, D.S.O. R.A.M.C. *Military Surgeon,* Oct, '17. 3800 words. Illustrated.]

(The writer gives the organization of sanitary units for duty with line troops in the British service. He then goes on to the discussion of miscellaneous items bearing upon sanitation in the field. With most of these matters officers of our service are already familiar.)

[Camp Sanitation in Trench Warfare. By Military Observer. *Marine Corps Gazette,* June, '18. 5000 words.]

All cases showing fever are immediately evacuated to a rest station where they can be observed and isolated.

Water supply is carried up with rations in petrol tins, from farm wells in neighborhood (chlorinated), in water bottles filled from designated sources, kept in jars in strong points.

Each man is supplied with three days "iron rations" to be used in emergency only, other rations carried up every night, in winter hot soup or cocoa or tea is brought up in petrol tins for use after 1 a. m.

Sullage water and washing water collected in tins to be carried back and emptied in soil or in holes.

Refuse is collected in sandbags hung up at intervals in the trenches, to be carried back and buried in the night.

Excreta are collected in petrol drums, flyproofed with 1 per cent cresol solution; the feces pails in addition are provided with automatic covers.

Bodies are generally brought back to cemeteries 1000 yards or more from the trenches.

The men are supplied with a powder to dust into clothes and an ointment to rub into seams of underclothes.

Rats are a great nuisance and numerous traps, dogs and ferrets are used for their destruction.

In order to eliminate trench feet, the trenches are drained as much as possible, waders are used, and puttees removed on coming into trenches.

In the reserve area food can usually be cooked without hindrance, water carts can be brought up, sullage water is carried off by radiating shallow trenches.

Clothing and bedding are disinfected by steam in a Thresh disinfector or by sulphur gas.

Bath houses and laundries are constructed usually one for each division.

The sanitation of any area is the duty of the O. C. in that area, his medical officer and his sanitary advisor. In addition he has a sanitary section of 27 men and a captain in charge. The business of this section is to co-ordinate the sanitation of the area and to inspect it.

[Ventilation in Barracks and Hospitals. By Antonio Parellada. *Mem. de Ingenieros,* Sept, '18. 4000 words. 3 figures.]

Hygiene demands not only that the old air in buildings be replaced by fresh air from the outside, but also that the air inside buildings be kept in motion so that all the air in a room shall be of approximately the same degree of purity.

This exchange of air can be effected in any one of three ways, a suction to draw air into a room so that it will force other air out, forcing air out of a room so that other air will be brought in to fill the partial vacuum so created, and forcing outside air in (practically the same effect as the first method).

Most of the article is a technical discussion of the limiting degrees of impurity which can be permitted in different classes of building.

—Dental Personnel and Service

See also

FRANCE—ARMY—SANITARY SERVICE (Article: "Military Mission to the French Army")

VETERINARY SERVICE

United States

[Work of the Army Dental Corps. *Army & Navy Jour.,* June 29, '18. Quoted.]

The dental requirements of an army of more than 5,000,000 men can now be met by the present force of the Dental Corps of the American Army. Examinations for dental officers have been closed and no further additions will be made to the corps for at least six months.

At the time the United States declared a state of war existing between this country and Germany, the total number of dental officers was fifty-eight. The present force numbers 5810. A record was made in the building up of this force. Commissions were offered to 5467 dentists in all parts of the country and all but two hundred and seventy-one were accepted, a percentage of 95.1. In the rapid development of the dental service, all credit must be given the patriotism of the members of the dental profession, the various preliminary dental examining boards, dental faculties, dental manufacturers, and officers and members of the Preparedness League of American Dentists, an organization which a year ago had a membership of 5000, but to-day has about 15,000 members, who have paid the membership fee and declared their willingness to render gratuitous service at least an hour a day when called upon to assist in making dentally fit the selected man after he has been certified to by his local board and previous to his induction into military service. The official record shows that 336,931 gratuitous dental operations have

been performed by members of this organization. This organization has been largely responsible for the three dental ambulances that have been presented to the Surgeon General of the Army.

A school for dental instruction has been started at Fort Oglethorpe, Ga. Eighty-five dental officers are assigned each month to take the two months' course. The first month is given over to 180 hours of general military instruction and training, and the second to seventy hours' special military training, and 110 hours devoted to professional subjects that have a definite relation to general practice of dentistry as it should be conducted in the army. Special dental infirmaries have been established in the camps and cantonments in this country to which every soldier is sent for examination shortly after arrival in the camp. The average number of tooth fillings is from 225,000 to 250,000 a month. This figure does not include the examinations, treatments, extractions, or crown, bridge and plate work. Dental inspectors are constantly visiting camps and cantonments to inspect work done by the camp dentists in order to determine if the dental officers are competent, are correctly assigned and to report on the general efficiency of the units. The same thoro care that is given to the men in this country is also given to the men in France. With each base, general or evacuation hospital there is attached a specialist in plastic surgery to correct deformities to face and jaws. Dental surgeons who have been specially trained in this class of work are also assigned to such hospitals.

—Establishments—Hospitals

See

HOSPITALS

—In European War

See

EUROPEAN WAR—SANITARY SERVICE

UNITED STATES—ARMY—SANITARY SERVICE

—Instruction and Training

[A Laboratory of Experimental Sanitation at the M.O.T.C., Fort Riley, Kansas. By Maj. D. M. Shewbrooks, M.R.C. *Military Surgeon,* Feb, '18. 2000 words. 2 photographs.]

(A brief description of the exhibits prepared for instruction in sanitation at the Fort Riley camp for training medical officers. A model kitchen was fitted out and surrounded by various types of improvised camp necessities and conveniences. Among these were an improvised ice-box and different styles of field ovens and kitchens. Many different patterns of accepted incinerators were built and some new ones developed. Special emphasis was laid upon the construction of latrines and upon anti-vermin measures.)

The course of instruction is as practical as possible. The construction, uses, advantages and disadvantages of the different types of apparatus are carefully explained to small groups of student officers upon the completion of their course of lectures in hygiene and sanitation.

A considerable amount of experimental work has been carried on, and many small improvements have been made in old apparatus, in addition to the development of new types.

[Lessons Derived from the Training of Medical Officers. By Capt. B. F. Duckwall, M.C. *Military Surgeon,* Mar, '18. 2200 words.]

(This is a general discussion of the methods used in the 79th Division in carrying out the requirements for an intensive course of instruction for the new medical officers, the enlisted men of the medical department, and candidates for promotion to the non-commissioned grades. The original idea of dividing the officers into classes for instruction was soon found not to be feasible, for two main reasons: (1) The regimental sanitary personnel were swamped by the large numbers of physical examinations of drafted men. (2) Routine work assumed such great proportions, on account of these physical examinations and because of inexperienced assistants, that much of the schedule had to be abandoned for the time.

Accordingly, the organization of classes was broken up. Each regimental detachment was constituted a class of its own, each surgeon being designated to carry out the instruction. Instead of a hard and fast schedule, memoranda were sent out weekly, giving the subjects to be covered during that week and the approximate time to be spent on each subject. Evening lectures for all the medical officers of the division were held.)

—Medical and Surgical Appliances and Equipment

See also

X-RAY—EQUIPMENT

[Dressings of Turkish Toweling in Italian Military Hospitals. *Modern Hospital,* Apr, '18. 200 words.]

The Italian military hospitals are using white Turkish toweling as bandages, abdominal binders, dressings to cover drainage wounds, and pad dressings to absorb irrigations.

These dressings were designed by Dr. Barbetti of Florence, a well-known Italian surgeon. They consist of five standard bandage dressings, first, two strip bandages, one made 5½ by 59 inches and the other, 4 by 43 inches, which can be used for all ordinary bandaging of drainage wounds of the head and extremities.

The larger dressings are adjustable and are practical for abdominal binders and irrigation pad dressings for the body and upper extremities. The larger abdominal binder dressing is cut 42½ by 16 inches and has five tails, on each of which is sewed a tape. There is another cut 20 by 18 inches, also with five tails, and another 17 by 24 inches with four short tails taped. These may be used for lower limbs and arms, hands, feet, and head.

All the dressings are whipped around the edges to prevent raveling and have the advantage of being both washable and durable. They replace cotton and gauze, the price of which is prohibitive in Italy now, and can be made by volunteer labor.

—Medical Statistics—Losses

See also

EUROPEAN WAR—LOSSES—ITALY (Article: "Note Relative to Some Sanitary Statistical Data of the Present War")

SANITARY SERVICE—Continued

—Nurses

[Training of Military Masseuses. *Modern Hospital*, Feb, '18. 200 words.]

Remedial massage for the treatment of convalescent soldiers is claiming the attention of the Canadian authorities. A regular six-months course for training eighty girl recruits from all parts of the Dominion has been inaugurated at the University of Toronto.

The masseuses are enlisted in a military sense, and are regarded on a par with their nursing sisters. They are admitted to the massage school only after having been declared fit for service. They engage to serve the Dominion for at least one year after graduation. They undergo physical training to qualify them for their strenuous occupation, while a staff of highly qualified instructors teach them the various subjects required to make them competent masseuses.

—Organization

[A Guide to Facilitate the Establishment and Administration of the Medical Group of Ports of Embarkation in Time of War or of Threatened Hostilities Involving Oversea Operations. By Lieut. Col. E. W. Rich, M.C., U.S.A. *Military Surgeon*, Oct, '17. 7000 words.]

(This paper has been prepared with the object of preserving and making available for use in the future the information and experience acquired by the medical personnel who were on duty with the Medical Group of the Port of Embarkation at Galveston, Tex., during the period of its organization, from March, 1913, to November, 1915.

The author treats in considerable detail the establishment, organization and duties of the medical service at such a port. Many valuable suggestions are embodied in the article as a result of the experience gained at Galveston. The paper does not lend itself to condensation, but should be consulted in the original by any officer connected with duty of a simliar character.)

—Preventive Measures

[Health for the Soldier and Sailor. By Prof. Irving Fisher, of Yale University, and E. L. Fiske, M.D. xxii +148 pages, 3¾ x 6½ in. *Funk & Wagnalls Company*, New York City. Price 60 cents net; by mail 64 cents.]

This little manual of sanitation and hygiene is by the authors of the successful "How to Live," from which it is largely an adaptation. That every man should keep fit is, of course, as important as that he should be well trained and disciplined. The present volume gives much valuable advice on what to do and what not to do in order that a man may keep in good health. It is conveniently bound in khaki cloth and is of a size that may be carried in the pocket.

[Communicable Disease at Camp Funston and the Medical Officers' Training Camp, Fort Riley, Kansas. By Maj. H. E. Eggers, M.R.C. *Military Surgeon*, July, '18. 10,000 words. Illustrations.]

(The author gives an analysis in detail of the various classes of communicable diseases occurring at these two camps during the period of mobilization, together with some discussion of the causes leading to their prevalence, and a description of the preventive measures taken. These latter consisted, in general, of the establishment of detention camps for the observation of all new arrivals at the stations, and the isolation of all who showed symptoms of diseases, as well as suspects and known contacts. A careful search was made for carriers, who were also isolated.)

As a result of the observations discussed in this article, the following prophylactic measures against respiratory disease appear to be of principal importance:

1. General care of hygienic conditions; provision of sufficient warm clothing; ventilation; adequate housing space; elimination of dust; minimizing the danger of direct personal transmission, particularly at night, by increasing the distance beween individuals, as by the alternate head to foot arrangement of bunk, or preferably by the extemporization of cubicles.

2. In the case of pneumonia, it may be advisable to segregate contacts; just to what degree would have to be determined by bacteriological controls.

3. For measles, regular inspection, preferably twice a day, of entire personnel, to be made with the men stripped to the waist.

4. For all diseases of this type, prompt removal of all cases and suspects. Contacts for measles are of doubtful importance.

5. For meningitis, repeated routine culture of the entire personnel, with prompt removal of all showing positive cultures.

6. The institution of quarantine camps for individuals removed as dangerous. Such camps should be made up of small units, to admit of the maximum degree of segregation.

7. The institution of detention camps, at which all newcomers, be they recruits or men returning from leave, may be kept until it has been shown that they are not harboring infectious disease.

8. Another factor capable of yielding good results is the education of officers and men as to the possibilities and dangers of transmission of diseases of this type, both as regards personal and general hygiene.

(The article is followed by a 2000 word report by Maj. E. K. Kerr, M.R.C., on the same general subject.)

—Preventive Measures—Inoculation

[The Reaction Following the Use of Antipneumococcic Serum. By Maj. Alfred Friedlander and Capt. S. C. Runnels, M.R.C. *Military Surgeon*, Mar, '18. 2800 words.]

After the use of antipneumococcic serum there is nearly always a reaction—at times very profound. This reaction seems to have no relation to the curative properties of the serum. Good results are obtained in cases of both mild and severe reactions. Also, severe reactions occur in cases without remedial response. The reaction is due to the introduction of the foreign proteid of the horse serum.

Before the first therapeutic dose is administered, desensitizing doses of gradually increasing amount are given. The usual therapeutic dose is 100 cc. of

serum. This is diluted with 100 to 150 cc. of normal salt solution, heated to slightly more than the body temperature and injected slowly into the veins, the conducting tubes being heated with hot-water bottles. It is the endeavor to inject the serum so slowly that half an hour will be consumed in the process.

The reactions following the use of the serum are so various that one can never know just what to expect. This is true both as to the time and the manner of the manifestations. While the symptoms are always various, the typical reaction may be divided into four stages occurring in rapid succession and a series of secondary symptoms occurring some days later. The first stage may be termed the stage of irritability, the second that of shock, the third that of hyperpyrexia, and the fourth that of relaxation. Any of these stages may be very lightly stressed or even entirely absent.

(The writers consider the variations of the different stages and the secondary reactions in considerable detail, discussing symptoms and palliative measures that may sometimes become necessary. A number of unusual cases are cited and described.)

The antipneumococcic serum reaction presents an exceedingly interesting set of symptoms which may undoubtedly be classed with that vast multitude of phenomena due to foreign and split proteid products, grouped under "anaphylaxis." When, however, the remedy is indicated, the possibility of reaction should not prohibit its use.

—Preventive Measures—Vaccination

See also

SMALLPOX

—Transportation of Sick and Wounded

See also

STRETCHERS

SUPPLY AND TRANSPORT (Article: "Mud Toboggan to Carry One Stretcher or 200 Pounds")

[Transportation of Wounded. By Capt. John Gilmour, M.C., R.A.M.C. *Military Surgeon,* Jan, '18. 5300 words. Illustrated.]

(This is a very good résumé of the various methods employed for the transportation of the wounded in war. The author gives a brief account of the organization and administration of the medical service of the British forces in France. The system by which the wounded are evacuated from the front lines to the rear is clearly outlined. The methods of transport in use on the western front are described in accordance with the following classification: (1) by men, (2) by conveyances carried by men, (3) by conveyances wheeled or drawn by men, (4) by conveyances carried by animals, (5) by conveyances drawn by animals, (6) by mechanical transport, (7) by railway transport, (8) by water transport.)

—Transportation of Sick and Wounded—Hospital Trains

[American Army's Ambulance Train Made in England. *New York Times,* Feb 3 '18. 600 words.]

An ambulance train embodying the latest ideas based on the experiences of this war has just been completed by the Midland Railway Company of England for the American force in France. The train consists of sixteen cars, with accommodations for 130 persons. The cars are khaki colored with two large red crosses on either side. Special care has been taken that the cars may be kept clean with the least effort. Floors are covered with linoleum and have rounded corners. Roofs are semi-elliptical with lofty airy ceilings. The train is vestibuled, and fitted thruout with electric fans. Water tanks in the roofs provide for 2835 gallons of water.

First in the train is the brake and infectious ward car, containing four wards, each fitted with six beds. Next is the staff car for the officers, with dining room, sleeping compartments, and lavatory and toilet accommodations. Directly in rear of the staff car is a kitchen car. Forming a part of this is a comfortably furnished room for "sitting" sick or wounded officers.

The nine ward cars are open thruout, with a lavatory at one end. Each car contains thirty-six folding cots in three tiers. An ample supply of drinking water and conveniences, such as paper racks and ash trays, is provided for each patient. The interiors of these cars are painted in glossy white enamel. The pharmacy car, which comes next, comprises a dispensary and treatment room, medical officer's office, linen room, pantry for medical comforts and an emergency compartment. Part of this car is partitioned off and provided with eight berths for the treatment of bad cases.

Next comes the kitchen and men's mess, followed by the personnel car. This is arranged similarly to the ward cars, but the mattresses are covered with cloth so they can be used as seats during the day. The last car is the brake and store car. Each car is fifty-four feet long.

—Transportation of Sick and Wounded—Motor Ambulances

[Notes, Experiences and Suggestions on the Automobile Ambulance Service of a Modern Army in the Field. By Stephen Thorn. *Military Surgeon,* Oct, '17. 12,000 words. Illustrated.]

(This article is based on nineteen months' experience at the front with the French Army. The author first drove an ambulance and was later Chief of Section in the Harjes Volunteer Ambulance Corps.)

The outbreak of the war found the French Ambulance Service in the most antiquated condition. It depended almost entirely on horse-drawn vehicles of the type developed during the Franco-Prussian War, having only two sections of automobile ambulances of twenty cars each. It at once became evident that the automobile ambulance was the only solution to the problem of handling the sick and wounded under modern conditions. Additional sections were added to the French army as rapidly as possible, but a long time elapsed before the service was near its proper strength of one section of twenty cars for each infantry division. Under these circumstances, much assistance was rendered by volunteers using their touring cars or cars with hastily constructed ambulance bodies.

SANITARY SERVICE—Continued

These ambulance bodies rapidly developed into two distinct types, the first of which may be called the American Ambulance type and the second the French army Kellner type. The former, built entirely on Ford chassis, was at first a four-stretcher ambulance, but as experience showed this to be too heavy for the light Fords, they were soon changed into three-stretcher cars. Two alterations were necessary to the Ford chassis in order to make them suitable for ambulance service. First, larger tires of equal size on all four wheels were required, and second, one extra leaf was needed in the rear spring.

In the American Ambulance type of body the stretchers rest on their legs, two on the floor of the car and the third in the upper part of the body on slides supported by crosspieces. These latter can be removed when the ambulance is used for sitting cases, four of whom can be carried, seated on boards placed across the car as near the driver as possible.

The chief advantage of a Ford for ambulance work at the front is its lightness and its great clearance. It will pull thru mud, fields, etc., which would leave a larger car hopelessly bogged. On the other hand the writer's experience seems to indicate that they are not sufficiently well built, and scarcely a day passed that at least one of the cars was not out of commission. The American Ambulance uses Fords successfully, largely due to the excellence of their repair system and to the fact that they paid little attention to wastage in cars. Another disadvantage of this type of ambulance is the enormous overhang of the body at the rear, putting a great strain on the rear axle. So great is this strain that in many cases the heavy wood supporting sills snapped off just in rear of the axle at the point where the actual Ford chassis ends.

The French Army Kellner ambulance was much slower in developing to its present form, and went thru three distinct stages. In its final form, which is now standard for the French Army, it will accommodate five stretcher cases, two stretcher and four seated cases, or eight seated cases. One stretcher rests on the floor of the car and the other four on slides which fold up against the central pillar when not in use. Formerly the stretchers were suspended in slings, but this soon proved to be too uncomfortable for the wounded. The ambulance is heated by turning the exhaust gases of the engine into a sheet iron box placed in the floor of the body. This can be turned on and off at will, and gives excellent results. These bodies are placed on all makes and powers of chassis, but the later sections are all composed of 12 to 15 horse power chassis, these having been found to give the best results, all things considered.

(The writer here proceeds to a description of the organization and personnel of an American Volunteer Ambulance Section attached to the French Army. He then adduces a number of personal experiences showing in an interesting manner the character of the duties of the ambulance sections. In closing, the writer presents some suggestions on the proper type of ambulance for use in this country. Having been connected with the automobile industry for seventeen years, touring extensively on both sides of the Atlantic, as well as having had nineteen months' experience in the ambulance service in the present war, it is believed that his views should carry a certain amount of weight.)

In selecting the type and make of chassis for ambulance service the following points should be kept in mind: (1) The nature of the country in which the section is to operate; (2) standardization combined with simplicity and a reasonable amount of lightness; (3) as great an amount of clearance as is possible without interfering with the stability of the car; (4) only the highest grade of construction and material should be considered.

In Europe it has been demonstrated that a motor developing from 12 to 15 horsepower (European rating) will furnish ample power for a frontal ambulance with a Kellner five-stretcher body. The conditions in the United States being quite different, however, on account of the bad roads and generally more difficult nature of the country, more power would be needed, and an 18-20 horsepower engine should be used. The problem resolves itself into two distinct parts: (1) The medium powered five-stretcher ambulance, type Kellner (for service in the middle and eastern states); (2) The light three-stretcher ambulance, American Ambulance type (for service in Mexico and the western states). Both types present advantages and disadvantages peculiar to each.

A 4-cylinder engine is preferred on account of its greater simplicity. All cylinders should be cast in one block. Valve springs and stems should be enclosed in a metal housing easily removed. The gravity or thermo-siphon system of water circulation may be used for small or medium sized engines, but the pump system is to be given preference. The carbureter should be fitted with a needle valve adjustment. The most convenient place for the gasoline tank in a chassis of this type is the dash-board. Under no circumstances should it be swung under the rear of the frame, as is customary in so many touring cars. The tank should have a capacity of at least 60 liters.

The most advantageous form of power plant is of the "block motor" type, meaning by this one in which the motor and gear box are in one mass, the fly wheel and the clutch being encased in a casting connecting the motor base and the gear box itself. This is a point of great importance, the fly wheel being thus protected under the severe going at the front. The suspension of the motor should be of the three point type. The gear box should contain four speeds forward and one back. The steering column should be set as near vertical as practicable. This allows the ambulance body to be placed well forward. To still farther reduce the overhang in rear a long wheel base is desirable. Good brakes are most important. The best type of wheel is that consisting of a thin pressed steel plate curved like a saucer.

The same type of chassis used for the ambulances

should be adopted for the officers' staff car and for the truck squad, varying the bodies to suit the different purposes required. The supply kitchen and repair trucks should be capable of carrying about 1½ tons.

Several small tents for the personnel are greatly to be preferred to large tents. The latter are not only very heavy but they require a great deal of time and patience to pitch. The practice of allowing the per-not be countenanced, disastrous results to the men's sonnel of a section to sleep in the ambulance should health being only too apt to follow. This is particularly the case when the exhaustion incident to prolonged efforts makes a certain amount of carelessness in disinfecting the ambulances more or less unavoidable.

SAPPERS

See

ENGINEERS—ENGINEER TROOPS

SAPPING AND MINING

See also

TUNNELS AND TUNNELING

[Sapping Operations, Especially for Infantry. (From a Lecture to Cadets at Saint Maixent, France.) By Capt. A. Gay, French Army. *Professional Memoirs*, Mar-Apr, '18. 3600 words. Figures.]

(This article gives detailed descriptions, clearly illustrated by the figures, of the various methods of making excavations by sapping. The subject is discussed under the following heads: The sap of rolling earth, *i. e.*, the ordinary sap with movable head parapet; the flying sap; the deep sap without parapet; the deep covered sap, in which the covering merely conceals without protecting; the blinded sap, in which the cover gives protection against balls and splinters; and the Russian sap, really a subterranean gallery with an arched roof having no sheeting. Most of the methods described are those employed for years in sapping, and with which all military men are familiar. Only those parts are digested which present new features or points of interest. It is to be noted that the dimensions now adopted for the sap are: Depth, 2 m.; width, 1 m. at surface and .8 m. at bottom; parapet, 18 inches high. The term "double sap" is now applied to a sap in which the full dimensions as given are secured in two operations, and not, as formerly, to a sap of greater size than the single sap.)

The double sap is employed in very close proximity to the enemy in order to advance at double speed. The two pioneers at the sap head work with short-handled tools and excavate a stage 1 m. wide at the top, .9 m. wide at the bottom, and 1 m. deep. They leave no berm at the sides as they need all the protection they can get. Two other pioneers with ordinary picks and shovels keep 3 m. in rear of the head of the work. They deepen the first stage to the final dimensions, using the excavated earth to increase the width of the parapet. They also push the earth from the edge of the sap over the parapet so as to make a regular berm .3 m. wide. This sap can be driven at the rate of from 2 m. to 2.5 m. per hour. The pioneers change posts with every meter they advance.

Turn-outs, 1 m. long and .6 m. deep, at intervals along the sap are recommended. To provide for the rapid evacuation of the sap in case of need, steps are built in the sap walls every 10 meters at the most. These steps are .45 m. in height and .5 m. in breadth and depth.

When the saps approach the enemy's trenches the pioneers should be protected against hand and rifle grenades. This is accomplished by placing over the sap head a wire netting, sloping both ways from the axis of the sap and supported by a frame work resting on the sides of the excavation.

[Mine Rescue Work. By Capt. H. D. Trounce, Engr. R. C. (Formerly Lieut., R.E.) *Professional Memoirs*, July-Aug, '18. 5200 words. Illustrated.]

Mine Rescue Work as applied to military mining embraces the use of axygen breathing apparatus and reviving equipment for the rescue and restoration of men who have been gassed by carbon monoxide and other poisonous gases encountered in mining. Too much emphasis cannot be placed upon the importance of thoro training in the care and use of this rescue apparatus.

Directly after an explosion has occurred, it is the duty of an officer to go below in oxygen breathing apparatus and investigate the extent of the damage. He usually carries with him a canary. These birds are very susceptible to poisonous gas and at once topple from their perches in its presence. Great care must be exercised in allowing men to return to work below after a blow. They should be provided with canaries and instructed to watch them carefully.

Carbon monoxide is developed by the detonation of high explosives and its presence, even in minute quantities, will cause death in a very short time. Incomplete detonation naturally results in an increase of CO. It must be remembered that the presence of CO in the atmosphere has no effect upon a naked flame, so its presence cannot be detected in this way.

In the British service the "Proto" apparatus, which weighs 35 pounds, is used where the investigation is likely to take longer than 20 minutes. For shorter times the lighter "Salvus" equipment is employed, this furnishing oxygen for about 30 minutes. In the American service the "Proto" and the newly designed "Gibbs" apparatus will be used. The "Proto" and the heavy "Gibbs" supply oxygen for some two hours, while the light "Gibbs" is good for about forty-five minutes.

(Descriptions of the Proto and Gibbs apparatus are given.)

After an explosion, a gallery must on no account be worked in until it has been ventilated by bratticing, or by some other method. The surest method is bratticing, which consists of dividing the shaft or gallery into two passages by means of temporary partitions, so as to form two airchannels—one for the exit of the foul air and the other for the intake of pure air. Work should be commenced by bratticing the shaft and placing a brazier at the bottom of the foul air passage to cause an up-draught. After work on the shaft has been

SAPPING AND MINING—Continued

completed, bratticing should proceed along the gallery step by step. Communication with the advanced party must be maintained by sight. It is advisable that the advanced party should be roped to the parties in rear to facilitate withdrawal in case of accident. A small alarm gong, to be used only as a signal of distress, should be provided with a string running along the roof.

By far the greatest number of cases of gas poisoning in mines are caused by carbon monoxide. Even when present in very small proportion—as little as 0.1 per cent—CO may cause serious symptoms, owing to its cumulative action. Breathing an atmosphere containing 0.2 per cent will cause unconsciousness in 20 to 30 minutes, and in the course of time, death in a painless form. All explosives (both high and low) give off noxious fumes, the most important of which are CO and nitrous fumes.

CO combines with the hæmoglobin of the blood, displacing the oxygen, so that all the tissues of the body suffer from oxygen starvation. In addition, it has a specific action on the blood, and thru the blood on the nervous system. The latter action is the cause of the most serious after effects.

The action of CO is intensified in the presence of other gases and where there is a diminished supply of oxygen—that is, where ventilation is defective. Increased muscular exertion, excitement, anxiety, marked mental strain, all hasten the action of CO. Men suffering from bronchitis, asthma or heart disease are very susceptible to the action of the gas, and should not be employed in mines where there is the slightest suspicion of its presence. Men with inherent weakness of the nervous system should likewise not be exposed. Some men are more susceptible than others, and a certain degree of tolerance may be established in time, but no man is ever immune.

(The author quotes at length from the British instructions concerning the methods of conducting mine rescue work, treatment to be given men gassed, and precautions to be taken in galleries where gas is present in such small quantities that work can be continued.)

—Use of in European War

[A Record of Mining Warfare. *Memorial de Artillería,* Oct, '17. 800 words. 3 photographs.]

Mining warfare has been greatly developed during the present war. At first very small quantities of explosives were used in land mines, two or three tons being the maximum. Now, however, this quantity has been increased to from 25 to 30 tons.

An example of this increase is given on the Italian front. In January, 1916, the Allies tried to destroy the Austrian defences on the Dolomite Alps, and especially on Mount Castelleto, which commanded the Corteana Valley. This peak is 3000 meters high and is full of natural and artificial caves in which the Austrians had placed artillery pieces of various calibers.

On Feb 3, 1916, mining operations began and observation stations were established to keep track of the Austrian installations. During February and March a tunnel 15 meters deep was dug in the rock by using picks and chisels alone. This hole was large enough to accommodate mining machinery, which was then installed. This included two air compressors, operated by gas engines, for the power drills.

The work was very difficult at first, as the opening of the shaft was 50 meters below the contemplated position of the explosive chamber, and the rock itself was crossed by innumerable dikes and volcanic cracks. It became necessary to place staircases in these cracks to carry men and material up to the shaft head and to carry the excavated material outside. In the level parts of the tunnel tracks were laid and materials carried back and forth by rail. By employing four shifts of six hours per day the shaft was dug at the rate of six meters daily. The total length of the shaft was 550 meters. Two thousand cubic meters of rock were excavated and removed.

The explosive charge, consisting of 32 tons of nitroglycerine, was equally divided in two chambers. The Austrians, aware of the Italian activity, countermined, reaching a point only a few meters from the Italian exploded. The entire top was blown off of the moun-charge of nitro-glycerine. The detonator for the Italian charge consisted of five tubes 3 cm. wide by five meters long, filled with alternate layers of dynamite, fulminate, gum, and some picric acid. One tube was placed in the center of the charge, the other four, one in each corner. They were fired electrically.

The chamber was charged beginning on July 3rd and ending on July 9th, and on the 11th the charge was tain.

The Italians could not reap the benefits of their advantage, because the Austrians had filled the caves in the mountains with asphyxiating gas shells which were detonated by the explosion of the mine, making the entire neighborhood uninhabitable for several days.

SCHOOLS, Military

See also
AERONAUTICS—INSTRUCTION AND TRAINING—SCHOOLS
BRAZIL—ARMY—SCHOOLS AND TRAINING
EDUCATION, MILITARY

—Military Training in

See
EDUCATION, MILITARY—IN SCHOOLS AND COLLEGES

—Officers' Schools

[A Divisional School for Officers in the Field in 1915-1916. By Capt. A. V. Gompertz, M.C., R.E. *Jour. United Service Inst. India,* Jan, '18. 9000 words.]

In times of peace Woolwich and Sandhurst alike said that a period of two years' training was necessary to make an officer, and after that, for at least three years more of service, one was training in one way or another. Technical training, social training, military training, all were carried out and only after five years did a young officer begin to be considered full fledged at all.

Officers had to be trained in less time than this, and in November, 1915, the High Commanders decided that schools must be formed and advantage taken of the lull in active warfare to make good as many as possible of the shortcomings of one single twelvemonth's hasty training.

In the Kitchener Division were over six hundred officers of whom not fifteen per cent were regulars, or even ex-regulars. Excluding the division and brigade commands and staff, the percentage was probably under ten. With this small number it was difficult even to furnish the necessary instructors. The technical troops had a greater proportion of regular officers and, therefore, were not included in the scope of the school.

About four months of inactivity could be counted on, so this was the period for which the course was laid out. The extremely short period of training at home made the field work practice of all but its engineers scanty to a degree. Therefore, field works were the first essential of the school; not so much actually to train the division for future fighting as to enable it to cope with the present evils and make its own life in its own trenches livable.

After field works attention was given to co-operation. Successful co-operation between arms involves a certain sufficient understanding of each other's work, such as will insure everything running smoothly with all the necessary give and take. The barest and shortest discourses had been possible in the employment of other arms but now lectures were arranged for by officers of each branch of the service: not upon their own work alone, but upon their work as regards co-operation.

After co-operation, a small amount of what might be called general education was taken up. One lecture and one afternoon's practical work were set aside for trench-mortar work, and one lecture on tactical bombing completed the course.

Thruout the whole course one aim was to be kept in view; and that was, not only to teach, but "To teach to teach." Each lecture was to be given out so that its recipients could deliver it again: each piece of practical work was to be carried out, investigated, and familiarized, in such a way that those who performed it could teach others afterwards the correct way of doing it.

Three field work courses for officers only were to come first. Each was to last fourteen days and to include two officers from each battalion. After those three classes assembled to meet very urgent present necessity, the course was to alter and expand. The later classes were to be of twenty-eight days each, only one officer from each unit attending. Field works were almost to disappear and tactical training to take their place.

The policy of the school was then to be as follows:

1. Field works and later on, tactical training, as the bulk of the course.
2. Co-operation to a lesser extent.
3. General education in two or three lectures.
4. In all and thru all, "Teach to teach," that is to ensure that the freshly acquired knowledge might be as quickly and as completely as possible promulgated thruout the division.
5. Non-commissioned officers to attend after the expansion of the course.

The daily schedule was as follows:

8:00 to 8:45. First lecture.
9:00 to 9:45. Second lecture.
10:00 to 4:00. Outdoor work, sometimes preceded by a ten-minute dissertation indoors.
5:30 to 6:30. Third lecture.

Two out of the three lectures were on field works every day except two, and on some days all three were on that subject.

During the outdoor period sandbag work was taught first of all. Revetment was studied in principle and the commoner kinds carried out in practice. The use and abuse of tools and materials in common use was gone into as far as possible. The proper use of timber was taught, stress being laid on the waste of manpower expended in bringing up unnecessary timber thru the long communication trenches or over the open. Some time was spent on wiring. The necessity of having a perfectly organized party and also of having as few men as possible outside the trenches at the same time, was pointed out.

Service explosives were taught to a modified extent; sufficient to inculcate a wholesome and not contemptuous familiarity, which would enable the learners to use them at a pinch without fear of mistake or accident.

Trench drainage was taught on sound if simple lines. The class was taught to lay and fix trench board ways on elevated frames where drainage could not be coped with.

One day's bridging was done, a pier bridge being constructed, mainly for the purpose of illustrating the correct use of timber in many ways.

A lecture was given on the siting and construction of a system of trenches, and siting and construction of machine gun emplacement. Practical work was done night and day.

Another subject which was dwelt upon was the organization and control of working parties. This included forethought in calculation and distribution of tasks and foresight in having all tools and materials close at hand; that is, the arrangement of the work so that more of the party might be temporarily idle and so that all should be able to give the best value for their time.

When the field works class was over, the school was expanded and tactical training took the place of most of the field work. Military operations of all kinds were studied. Map reading and field sketching were introduced. Tactical schemes and reconnaissances formed the bulk of the outdoor work.

Outdoor tactical schemes were carried out two or three times a week; co-operation was taught in theory and thoroly embodied in the schemes. As well as recapitulating the long dormant art of open warfare, certain unavoidable results of protracted months in the trenches were combatted; the chief of these were monotony of daily events and laxity of turnout. Drill

SCHOOLS, Military—Continued

was brought to the fore and the class was turned out for parade every day.

Inter-brigade contests were held and then followed battles of the division against various objectives and a skeleton enemy. The school followed the maneuvers day by day, digested operation orders, conducted and reported upon reconnaissances and appreciated situation; all its work being corrected and discussed at a meeting every evening.

SEACOAST ARTILLERY

See
COAST ARTILLERY

SEAPLANES

See
AERONAUTICS—SEAPLANES

SEARCHLIGHTS

[Night Exercises. By X. *Memorial de Caballeria,* Oct, '17. 4000 words. 1 sketch.]

(This is a continuation of the account of the night exercises held by the Fourth Section (Cavalry) of the Central School of Fire. Experiments were made in night firing with carbines and machine guns, alone and in combination with the searchlights of a field explosive chambers, where they placed a three ton illuminating unit.)

Divergent projectors have a practicable range of a little more than half those of those throwing a cylindrical beam. The width of the front illuminated by the cylindrical type is equal to about one-twelfth of the range, while with the divergent type it is about four times greater. For this reason the divergent type is better suited for the fire action of infantry and dismounted cavalry. Under ordinarily good conditions troops of these arms can deliver effective fire at ranges of from 400 to 600 meters, and in exceptionally favorable conditions even up to 800 meters.

Troops armed with rifles, carbines and machine guns that are to work in combination with field projectors, in accordance with the latest information, should normally be established in advance of the projectors, at a maximum distance of 1500 meters, to the end that they may deliver effective fire upon illuminated objectives at ranges of from 400 to 800 meters. The effective range would vary within the limits given according to the position of the fires with reference to the projectors, the size of the target, color of uniforms, background, general visibility, etc.

Field projectors are used ordinarily in pairs, one to seek, locate and observe objectives and the terrain near same, and the other to illuminate and follow objectives, so that fire may be directed properly upon them.

The following data are taken from *Les Projecteurs de Campagne* by Gaston Breton and an interesting article in *La Guerra y su Preparación* entitled *Instrucción de Proyectores en el Ejército Francés.*

The data apply to the use of the cylindrical sheaf or beam. Troops in the kneeling position reduce their visibility one half. When in the prone position there is a still greater reduction:

ELECTRICAL PROJECTORS OF 90 CENTIMETERS

		Visibility range (Observer at or near projector)	Visibility range (Observer 200 meters from target)
Houses, with dark background	Naked eye	2500 m.	4000 m.
	Field glasses	3500 m.	4500 m.
Houses, with light background	Naked eye	2000 m.	3000 m.
	Field glasses	3000 m.	3500 m.
Troops in mass, with clear effect and dark background.	Naked eye	1500 to 2000 m.	2000 to 2500 m.
	Field glasses	2000 to 2500 m.	2500 to 3000 m.
Solitary man, standing, with clear effect upon dark background.	Naked eye	600 to 800 m.	1000 m.
	Field glasses	1200 to 1400 m.	1600 to 1800 m.

ELECTRICAL PROJECTORS OF 60 CENTIMETERS

		Visibility range (Observer at or near projector)	Visibility range (Observer 200 meters from target)
Houses, with dark background.	Naked eye	2000 to 2500 m.	2800 to 3000 m.
	Field glasses	2800 to 3300 m.	3000 to 3800 m.
Houses, with light background.	Naked eye	1800 to 2000 m.	2200 to 2500 m.
	Field glasses	2000 to 2500 m.	2800 to 3000 m.
Troops in mass, with clear effect upon dark background.	Naked eye	1200 to 1500 m.	1500 to 2000 m.
	Field glasses	1500 to 1800 m.	2000 to 2500 m.
Solitary man, standing with clear effect upon dark background.	Naked eye	600 to 700 m.	800 m.
	Field glasses	1000 m.	1400 m.

ELECTRICAL PROJECTORS OF 25 CENTIMETERS OR OXICETYLENES OF 40 CENTIMETERS

		Visibility range (Observer at or near projector)	Visibility range (Observer 200 meters from target)
Houses, with dark background.	Naked eye.	1500 to 2000 m.	2000 to 2500 m.
	Field glasses.	2000 to 2500 m.	2500 to 3000 m.
Houses, with light background.	Naked eye.	1000 to 1200 m.	1400 to 1800 m.
	Field glasses.	1200 to 1800 m.	1500 to 2200 m.
Troops in mass, with clear effect upon dark background.	Naked eye.	800 to 1000 m.	1000 to 1400 m.
	Field glasses.	1200 to 1500 m.	1400 to 1800 m.
Solitary man, standing, with clear effect upon dark background.	Naked eye.	600 m.	700 m.
	Field glasses.	800 m.	1000 m.

[Military Searchlights. By Lt. Roger Haydock, E.O.R.C. *Professional Memoirs*, Mar-Apr, '18. 2500 words. Illustrations.]

Warfare has been largely responsible for the development of the searchlight. During the last fifty years it has been used by both the army and the navy, but chiefly in a defensive way. At first the army used it in connection with permanent fortifications, both land and seacoast. Later, as military science developed, it became necessary to bring the searchlight up to the front, where it has played an important rôle—being used to discover artillery, machine guns and riflemen of the enemy, and to give the friendly troops a good target. Since the advent of military aircraft the searchlight has been developed with giant strides. We now have military searchlights divided into the following groups:

(a) Searchlights of position, whose caliber ranges from 90 cm. upwards; (b) the field searchlight, light and mobile, of medium power (about 60 cm.), particularly adaptable for field operations, and finally (c) the trench searchlight, used to illuminate the immediate foreground and obstacles of the trenches. These last must be very light and mobile in order to insure their quick and easy transportation. Their caliber ranges from 25 to 40 cm.

With the development of the mobile searchlight, new missions were assigned to it, some of them offensive in character, such as blinding the enemy and interfering with the use of his lights. Searchlights also play an important part in signalling.

(The author discusses briefly some of the recent improvements in searchlight design, such as the flame electrode and the small crater carbons. He then describes in detail a recent type of searchlight used in the Italian Army.)

[Note. *Canadian Military Gazette*, Apr 23, '18. 90 words.]

Searchlights have often been used in warfare as a means of discovering enemy forces, but the Italians have put searchlights into play in order to blind the enemy to an advance against them. In a recent movement of troops the Italians desired to cross a deep gorge on the other side of which the Austrians were stationed. The Italians therefore concentrated the glare of scores of powerful searchlights upon the Austrian position, so blinding the enemy that it was possible for engineers to throw bridges across the gorge undetected.

[Night Illumination in the Field. By Ramiro R. Borlado. *Mem. de Ingenieros*, Feb, '18. 2600 words. 6 figures.]

(A brief discussion of work during 1916 of the Spanish searchlight school, which worked in co-operation with the Cavalry School of Fire.

The plan was to operate this school thruout the entire year except during the worst of the winter. The course was divided into a theoretical course and two practical periods.

The first practical period had five different objects or purposes, as follows:

1st. To complete the theoretical instruction of the personnel by requiring them to do practical work, during the course of which they would meet with various troubles which would have to be overcome.

2d. Tactical uses, such as the illumination of broken country and night operations under the direction of the Chief of the Searchlight Service.

3d. The use of searchlights for illumination work at night.

4th. Visual signalling.

5th. Marching and the problems of transportation, by night and by day.

The material available for use was divided into two sections, one of 90 centimeter lights, and the other of 60 and 25 centimeter lights. The first section was composed of three lights, two animal drawn and one motor drawn. The other was composed of two 60 cm. lights in vehicles and four 25 cm. carried on pack animals.

A detailed discussion of the work would be meaningless without the figures.)

—Portable

[Advanced Base Searchlights. By Major Howard C. Judson, U.S.M.C. *Marine Corps Gazette*, Dec, '17. 8000 words. Photographs.]

In the design of a searchlight, military requirements must give way to mechanical ones and the necessity of a quick and accessible source of supply for replacements must be considered. To make a light and easily

SEARCHLIGHTS—Continued

portable projector it is necessary to use aluminum.

On the western front it has been found that the average time that it is possible to use a searchlight without a strong probability of losing it is thirty seconds. This, of course, is when the projector is directed on the enemy's position from a point near the first line trenches. The position of the light is readily plotted by azimuths sent in from observation stations and it takes but a moment to compute the range and azimuth from the gun, lay the gun, and fire the first salvo. Therefore it is necessary to move the searchlight instantly. If the projector is light and easily portable, this is not a difficult task; but if the light is heavy and unwieldy or is fastened to an elevating tower, which takes two or three minutes to lower and then requires that horses be brought up to drag the lamp cart away, it is certain to be lost. Only when the enemy's artillery is so busy repelling an attack that it cannot afford to waste the time necessary to destroy the searchlight is it safe to use one for any length of time on the battlefield.

As a consequence of the fact that we must expect an effective fire a few moments after we start to use a lamp we must be prepared to obscure the lamp, move it rapidly from the vicinity and get the cable away from the spot as quickly as possible. In order to do this, searchlights are mounted on a light man-drawn four-wheeled cart. The cable is carried on a small cart of its own, and as much as possible is used in order to get the generator set sufficiently far away from the lamp so that a stray shell will not destroy it. When the lamp is fired upon, the cable is instantly withdrawn from its receptacle in the base of the lamp and the dynamo tender notified by telephone to shut off the current. The crew then withdraw the lamp as rapidly as possible. While the lamp crew are removing their lamp, the linesmen and the spare dynamo tender have seized the cable at a point about two hundred feet from where the searchlight formerly was and are dragging it toward the generator set. The dynamo tender and the non-commissioned officer in charge have gotten the automobile truck, upon which the generator set is mounted, under way and are already proceeding to a prearranged point where all parties meet to recommence operations.

The light extremely portable type of searchlight is a lamp which one man can take anywhere that a man can go. This type is carried on a two-wheel buggy which also carries the cable reels, two reels of 500 feet each which can instantly be detached from the buggy and thrown aside if the occasion requires. The lamp likewise may be detached from the buggy and carried to a place of safety by its tender.

A searchlight must not illuminate its own vicinity or the enemy will be able to spot his shots. Otherwise the spotter will lose sight of his tracers as soon as the projectile gets anywhere near the beam, and he will not know if his fire is going high or low. He must obtain a direct hit on the lamp itself, or a hit so close to the lamp that the shell will destroy it with its fragments. However, high explosive shell is not very effective in open air as the fragmentation is too small. As a consequence all the light given forth by the lamp must be condensed so as to shine on the target and the target only.

To effect this concentration of illumination a parabolic reflector is used in the searchlight barrel. Some searchlights are provided with metallic reflectors, but these, which have all the advantage of not being completely shattered by one rifle bullet, are even less efficient than the glass mirrors. The electric arcs are invariably of the horizontal type. The arc is regulated by an automatic mechanism which is intended to keep the flow of current across the arc constant.

The Sperry lamp burns its carbons faster than the ordinary type and they are in consequence very long When intended to be used in anti-aircraft work both types of lamp are provided with a small wire screen to protect the mirror from fragments of carbon which may fall from the arc and crack or melt the face of the mirror from their intense heat. The cores of these carbons contain metallic oxides so they do not burn when heated and do not readily vaporize. The efficiency of the Sperry light is due to the fact that thru greater conductivity he is able to use smaller electrodes, thus reducing the area of illumination, and the fact that the crater in the positive carbon is so much hotter, not being cooled constantly by the latent heat of vaporization of the liquid it contains. There is a blue color to the Sperry lamp which is troublesome in land work but is a positive advantage in marine work.

Our lamps are safe from observation by the enemy's aircraft in the daytime as we remove all sets at daylight to some point where they are certain never to be at night. Generator sets are so built that they can be taken off the truck carrying them and placed anywhere upon a spot which is nearly level, and operate without the necessity of bolting them down to foundations. Their balance is such that there is no vibration at no load or full load and when used in fixed defense work they can be put in an underground casemate. The standard cable is for fixed defense work where it may be buried and will not often be moved. For portable work an extra flexible cable is used; this will stand constant reeling and unreeling. The cable carts are constructed so as to permit access to both ends of the cable thus obviating the necessity of unreeling all of it to get at the other end. With non-reversible plugs, either end may be attached to the searchlight and the other to the generator set without danger of reversing the polarity. The large lamps may be used either in fixed defense or with field artillery; the small ones with infantry on advanced base work.

—Tactical Use of

[Use of Searchlights in Campaign. *Mem. de Ingenieros.* Sept. '18. 270 words.]

In certain portions of the western front the Allies assign searchlights as follows: Each division has two 90 centimeter and four 60 centimeter lights, which form part of the divisional engineer train. These are divided into groups of three. In each group the 90 centimeter light is placed in the center, and the smaller

ones on the flanks, with intervals of 1000 meters, so that the divisional lights can illuminate a front of 4 kilometers, leaving two lights in reserve. When possible, the command post of the searchlights is connected by telephone to the sector commander, all the observers being in telephonic communication with this command post. The observers are usually located at least 50 meters from a light, to one side where possible. The large lights are used for exploration, and the smaller ones for illuminating the foreground and observing the effects of fire. Of necessity, the work of these lights is intermittent, to avoid the effects of the hostile artillery fire.

Recently there has been adopted a trench searchlight made of an incandescent bulb with a reflector mounted on a pole and run by a storage battery which can give continuous light for five hours. Due to its intermittent use, these batteries are usually expected to give at least two nights of service. Each division has 24 of these trench lights, each one of which can light up a front of 200 meters. Their use in the trenches is, however, very dangerous for they make excellent ranging points for hostile artillery fire.

SECURITY AND INFORMATION

See also

ESPIONAGE
PHOTOGRAPHY, MILITARY
SIGNALLING
SURPRISE

—On the Battlefield

[Telephone Communication in Intrenched Areas. *Mem. de Ingenieros,* May, '18. 280 words.]

The following is taken from the book, "Feldbefestigung und technischer Unterricht":

For each infantry company which occupies the front, there is a company central which communicates with the sections in the first line, with the reserve, and with the company commander, who is not necessarily at the company central. The sector central communicates with the three centrals of the companies of the front, with the reserve, with the chiefs of the artillery groups, and with the sector commander. In each artillery group the central communicates with the batteries and with the commander. The artillery observer communicates with the batteries and with the commander. The artillery observer communicates directly with his battery.

If the telephone lines are buried to a depth of two meters, they will be protected from injury by anything except direct hits by shell fire, but in this case they are so difficult to repair that aerial lines are generally employed. At a distance from the enemy it is permitted to use one wire only, the current returning thru the ground. Within 500 meters of the enemy, however, it is necessary to use two wires to avoid the interception of all messages by means of the induction of the ground. In the front lines the ground return will not be employed. Important lines should be laid with two wires, somewhat separated, connected at intervals by conductors, so that in case one wire is broken the line will not be broken.

SERBIA

—History

See also

BALKAN WARS

SHARPSHOOTING

See

INFANTRY—FIRE

SHELL SHOCK

[Notes on Shell Shock. By Maj. E. K. Johnstone, Formerly Surgeon, U.S.V. *Military Surgeon,* May, '18. 3200 words.]

Shell shock is a comparatively recently recognized disease produced by the effects of the new tremendous high explosives combined with trench warfare. It is the result of concussion and commotion in relation to the central nervous system. Cases of shell shock seem to fall into three classes as they appear before the surgeon:

1. Neurasthenia and hysteria, usually found in the neurotic soldier who is unable to bear the strain of modern warfare. These cases are harder to care for than the cases where a strong, normal man suffers from real shell shock.
2. Malingering by soldiers who desire to return home temporarily, or perhaps to be permanently invalided out of the service. These men have seen how little real evidence of injury often exists and know how difficult it is to detect the spurious imitation.
3. Genuine shell shock, the signs and symptoms of which vary considerably.

(Follows a brief discussion of the disease, some of its symptoms, and treatment. Several interesting cases from actual practice are cited.)

SHIELDS

Sec

BULLET-PROOF SHIELDS

SHIPS AND SHIPPING (Merchant)

See also

CONVOYS AND CONVOYANCE

[How a Ship's Tonnage Is Figured Four Ways. *Official Bulletin,* July 16, '18. Quoted.]

The Shipping Board authorizes the following:

To many persons who are not experienced shipbuilders the various uses of the term "tonnage" in relation to the size of a ship may be confusing. The following article from the "Pusey & Jones Shipbuilder" explains the terms well and makes a clean distinction between the various ways in which they are used:

There are four kinds of tonnage in use in shipping circles. They are gross tonnage, net registered tonnage, dead-weight carrying capacity, and displacement.

Dead-weight tonnage is what the vessel actually can carry in tons of heavy cargo, plus stores and bunker coal.

Gross tonnage is based on the cubic contents of the hull, with certain arbitrary spaces deducted, and has little bearing on the cargo-carrying capacity of the vessel.

SHIPS AND SHIPPING—Continued

Net registered tonnage is gross tonnage, with certain allowances for crew space and machinery space deducted, and has little bearing on the dead-weight carrying capacity of the vessel.

Displacement is the total weight of the vessel when full of cargo—that is, the weight of her hull plus her dead-weight tonnage.

In round numbers a ship of 9000 tons dead-weight would stand about as follows:

Dead-weight carrying capacity	9,000
Gross tonnage	5,000
Net registered	3,000
Displacement	12,000

[Status of World Tonnage, September 1, 1918 (Germany and Austria excluded). *Official Bulletin*, Sept 24, '18. Quoted.]

	Deadweight tons
Total losses (allied and neutral) August, 1914-Sept 1, 1918	21,404,913
Total construction (allied and neutral) August, 1914-Sept. 1, 1918	14,247,825
Total enemy tonnage captured (to end of 1917)	3,795,000
Excess of losses over gains	3,362,088
Estimated normal increase in world's tonnage if war had not occurred (based on rate of increase, 1905-1914)	14,700,000
Net deficit due to war	18,062,088

Allied monthly construction passed destruction for the first time in May of this year (1918).

In August, deliveries to the Shipping Board and other seagoing construction in the United States for private parties passed allied and neutral destruction for that month. The figures:

	Gross (actual) tons
Deliveries to the Shipping Board	244,121
Other construction over 1000 gross	16,918
Total	261,039
Losses (allied and neutral)	259,400
America alone surpassed losses for month by	1,630

NOTE.—World's merchant tonnage, as of June 30, 1914, totaled 49,089,552 gross tons, or, roughly, 73,634,-328 deadweight tons. (*Lloyd's Register.*)

[World Shipbuilding Record Set by U. S. During October. *Official Bulletin*, Nov 9, '18. Quoted.]

The United States Shipping Board issues the following:

All shipbuilding records for any country were broken by the total deliveries of completed new ships to the Shipping Board during October. In spite of the epidemic of influenza that incapacitated about one-third of the shipworkers the record-breaking total for September was surpassed by nearly 50,000 dead-weight tons. There were added to the American merchant marine in October 79 completed new ships of 415,908 dead-weight tons.

Class of Vessels

The deliveries comprised 47 steel ships of 301,208 dead-weight tons, 30 wood ships of 107,200 dead-weight tons, and 2 composite ships of 7500 dead-weight tons. From American shipyards came the unprecedented total of 398,108 dead-weight tons. Japanese shipyards delivered 2 steel ships of 17,808 dead-weight tons. The American total exceeds by 68,980 dead-weight tons the output of ocean-going vessels in this country in 1914 and 1915. It betters the pre-war high mark in American shipbuilding, the total for 1916, by 112,553 dead-weight tons. It also surpasses the British record for any month by 102,397 dead-weight tons.

Once more the Pacific coast led all sections of the country in shipbuilding. The deliveries from California, Washington, and Oregon totaled 30 vessels of 190,400 dead-weight tons. Along the Atlantic coast there were completed and delivered 17 vessels of 102,-000 dead-weight tons. The Great Lakes shipyards delivered 21 vessels of 73,000 dead-weight tons. From the Gulf States came 9 vessels of 33,200 dead-weight tons.

Total for 1918

The October deliveries bring the total of completed new ships in 1918 up to 2,386,835 dead-weight tons. Since that date of the first delivery, Aug 30, 1917, there have been completed and delivered 487 ocean-going vessels totaling 2,793,510 dead-weight tons.

SHRAPNEL

See also
BULLETS

—Timing of

See also
FIELD ARTILLERY—FIRE

SHOCK TROOPS

See
INFANTRY—TACTICS—SHOCK TROOPS

SHOES AND BOOTS

See also
FEET—CARE OF THE

[Substitutes for Sole Leather. *Svensk Intendentur Tidskrift*, No. 1, '18. 700 words.]

The lack of raw material of different kinds due to the world war has caused almost all industries to make other dispositions or to change their manufacture and to make experiments in substitute articles. The lack of leather in our country, the importation being cut off, has spurred private enterprises as regards leather soles, to find a variety of substitutes, from a great variety of metal soles up to wooden soles and soles of felt or cattle hair compositions.

Altho the metal soles of any construction must be considered less convenient for military purposes on account of being a good conductor for heat, the wooden soles as well as preparations of felt were considered to have such an importance for the army that trials of such material are to be undertaken in our army this year (1917).

The types of sole which have been tried are the so-called marathon sole and the ming sole. The former consists of wool or cattle hair composition which has been treated with some connecting and strengthening

preparations. The ming sole is made of wood in several layers which are easily separated from each other. The marathon sole has been acknowledged by most of our divisions to be a splendid substitute for the leather sole. Some unfavorable results have been reported, but these are without doubt caused by careless attachment of the sole and by not keeping it in good condition during wear. The best way of attaching the marathon sole is by sewing and not by pegging. In some parts of the army they sole the shoe with iron or soak it with wood tar or other adequate preparations, taking care to cut uneven outer edges, etc. The total impression of the reports on the marathon sole is excellent; it fulfils the expectations to a high degree.

The ming sole is less suitable for military purposes. Sand and gravel are easily pressed in between the layers, causing a deformation of both the sole and the shoe and annoyance to the wearer. The nails by which the sole is attached to the shoe do not wear as quickly as the wood of the sole, which causes the nails to penetrate the inner sole and to hurt the foot.

Knowing to what immense extent wooden soles are used in the armies of the central powers, especially in Austria-Hungary, we may expect that the technical inconveniences may be removed by and by, and that the wooden sole may become a good substitute for the difficult to obtain and mostly sole leather.

SIEGE ARTILLERY

See also
ARTILLERY

SIGHTS

See also
INFANTRY—ARMS—RIFLES—SIGHTS
PERISCOPES—FOR TRENCH FIRING

SIGNALLING

[Liaison Sections. By Aparicio. *Memorial de Caballería,* Aug, '18. 2500 words. Photographs.]

The following adoptions have been worked out by the Cavalry Board and tried out at the Military Academy. This has been largely thru the efforts of Col. Moreno de Monroy and Sr. Pérez.

A Demolition and Liaison Section, similar to that of a Cavalry Regiment, has been formed at the Cavalry Academy. It has been equipped with the Erricc-son telephone, due to the latter's sensitiveness, long life of battery, lightness, and high efficiency. A buzzer covers case of damage to the microphone.

The entire set is packed on one mule; in the top load, which is a box, is the central station; in the side loads, two in each box, are the four terminals. Under these are packed four reels each of five kilometers of wire. Climbing irons, spare parts, etc., are carried in the top load.

Col. Amieba has devised a laying device that may be used at a gallop.

Tests at the Military Academy with the twenty centimeter mirror heliograph showed a total weight of thirteen kilos, far too heavy. Accordingly, the fifteen centimeter instrument made by Berdala, Madrid, has been tried. Special features are a sight, made of a circle and cross wires, and a revolving plate over this to take the projection of the shadow spot. There is a unique adapter between the sight and the secondary mirror, and the operator's seat has been done away with. This instrument needs a few modifications, a metallic buffer instead of a rubber one under the key, and a different articulation in the rod fastening the main mirror. This heliograph, together with the Swedish A. G. A. acetylene signalling lamp on a common tripod, range thirty kilometers, is carried and operated by two mounted men.

A wireless outfit in use is carried in the side car of a motorcycle, the dynamo being run by the motorcycle. Antennae are carried in a second side car. This has an effective range of ninety kilometers.

—Electrical

See also
TELEGRAPHY
WIRELESS TELEGRAPHY

—On the Battlefield

[Notes on Employment of Regimental Signallers. By Capt. N. M. Carruthers, 30th Punjabs. *Jour. United Service Inst. India,* Jan, '18. 5000 words.]

A brigade signal section forms part of the divisional signal company, which is organized into four sections. No. 1 section is used for the establishment of communication between divisional headquarters and the headquarters of infantry brigade and other units or groups of units. The other three sections are organized for employment with infantry brigades for communication between the brigade commander and units under his command. All that a unit can expect is to be connected up by telephone with brigade headquarters by the signal section.

Battalion commanders must have a fixed headquarters somewhere where they can always be found. The guiding factor in the choice of headquarters is the provision of facilities for the issue and receipt of orders and messages; the position will depend largely on the method by which these are received and sent. Battalion commanders must, therefore, take into consideration the necessity of being where they can communicate with brigade headquarters and with different units of their command. The position must be known to brigade headquarters, to company commanders, and to units on the flanks.

The battalion signal officer is responsible to his commanding officer for maintaining communication from the headquarters of his units to:

(1) Brigade headquarters.
(2) The component parts of his unit.
(3) Units on either flank of his own unit.

He should remain with battalion headquarters and must have the earliest possible information of the plans of his commanding officer so that he can make arrangements for communication.

It must be remembered that it is not always quickest to send a message by signal. The following points must be considered:

(1) The length of the message.

SIGNALLING—Continued

(2) The distance it has to go.
(3) The necessity for concealment.

It may be quicker to send the message by runner, tho at times, even over short distances, signalling may be the safest method. Regimental signallers work at the rate of eight words per minute, not considering the time necessary for the signaller to read the message or to have it delivered to the addressee.

There are several technical ways of speeding up mssages which all signallers should know, but all officers can help in this to their own advantage.

(1) When possible, they should always have their signallers alongside them so that they can read a message as it is being written by the signaller, and perhaps be able to make arrangements to act on it before the message is completed.

(2) Messages must be written legibly so that the signaller can start sending it straight away without having to decipher it or keep asking what various words are.

(3) All messages must be as short as possible.

(4) Signallers should not be used as runners or orderlies, or, when an important message is coming in they are sure to be somewhere else.

(5) Much time will be saved if each battalion has abbreviated addresses for its headquarters, companies, and machine gun attachment.

The great disadvantage of visual signalling is that it is apt to disclose positions to the enemy, and, except when the helio is used, is slow and uncertain. It is useless in close wooded country, and the signals are liable to be read by the enemy. Signallers must always be made to take cover; they should never be allowed to wave their flags in the open; they should be taught to avoid positions along the sky line.

The great advantage of the telephone over visual signalling is that by it we can communicate with any other place from under cover, and no arrangements have to be made to ensure that the two places, between which we want communication, are visible to each other. The commander is, therefore, freed from the necessity of fixing his headquarters somewhere near a signal station. Telephone lines will be found most useful between bivouac and pickets; between detached forces they will seldom be left intact. When possible they should be supplemented by visual communication.

The main object to be kept in view in the training of signallers is to bring them to the highest state of efficiency in all duties required of them in the field. Too much time is often spent in technical work on the parade ground. They get no practice in working from under cover and at distances they would have to work out in the field. As soon as men have learned to read and send on all the instruments and have a knowledge of how to deal with messages, the rest of their training should take place in the field under practical conditions; and every opportunity should be taken of working them with troops.

As telephones are now the most important means of communication it is absolutely necessary that signallers should be experts in their use. If communication breaks down they should know immediately what has gone wrong and be able to repair it in a very few minutes.

SIND, Conquest of

[The Conquest of Sind. By L. Fitzgerald. *United Service Mag.*, May, '18. 3000 words.]

(Historical. An account of the campaign under Sir Charles Napier which began in January, 1843, and resulted in the conquest of Sind. The force used comprised originally about 3000 men, with which the battle of Meanee was fought and won on Feb 17. Then reinforced to 5000, the battle of Hyderabad was won on Mar 23. No other serious fighting occurred, and the war was ended on June 9.)

SITUATION, Military

See also
EUROPEAN WAR—GENERAL NOTES

SKETCHING

See also
ENGINEERS—INSTRUCTION AND TRAINING (Article: Sandbox Instruction, Etc.")

SMALL ARMS

See
INFANTRY—ARMS

SMALLPOX

[A Study of the Comparative Number of Successful Vaccinations by the Cross-scarification and the Incision Methods. By Maj. E. D. Kremers, M.C., U.S.A. *Military Surgeon*, May, '18. 3000 words. 3 tables.]

(While on duty at Fort McDowell, California, the Pacific Coast Recruit Depot of the Army, the writer took advantage of his excellent opportunity to investigate the vexed question as to the best method of administering the smallpox vaccination. The study was extended over a period of six months. This paper is based upon the results of that investigation. The article is self-summarized as follows:)

1. The method of incision is the only vaccination method which should be used in the military and naval services. It should be the method of choice for all vaccinations.

2. The cross-scarification method gives a slightly higher percentage of "takes" than the incision method in unprotected persons.

3. The total "takes" secured were 87.1 per cent in 257 unprotected men by the incision method, against 92.4 per cent in 225 unprotected men by the cross-scarification method.

4. The percentage of "takes" secured by the incision method is sufficient, when carefully done, to prevent epidemics of smallpox.

5. The slightly higher percentage of "takes" secured by the cross-scarification method is offset by the increased number of infections.

6. Medical officers should be assured of the protection against smallpox afforded by vaccination carefully done by the incision method.

SMOKELESS POWDER

See
POWDER—SMOKELESS

SOMME, Battle of the

[The Battle of the Somme. By Capt. A. V. Gompertz, M.C., R.E. *Jour. United Service Inst., India,* Oct, '17. 12,000 words. 1 map.]

It was on the Somme that the Allies definitely and finally gained the initiative in the west. The change came at the beginning of 1916. It came by degrees, but those degrees were of the most marked surety and followed one another in quick succession. By June, 1916, they were literally flooded with guns, men and ammunition. On the first of July, 1916, our strength in leash was let loose, and from that very day we took to ourselves the initiative in the west.

That was the first importance of the Somme.

The second point of importance is that every man in the west is now fighting day by day on what he, or his teachers, learned on the Somme.

The third point of importance is its correlation with after events:

(a) The Somme began on July 1 and made a doorway for the Ancre campaign which joined it towards the end of the month.

(b) The Somme and Ancre proceeded side by side until the Somme was over on Sept 26, the Ancre halted.

(c) The Ancre had its finale on Nov 13 to 17, when we took Beaumont Hamel and Beaucourt.

(d) At the ends of these two campaigns we knew that the enemy would have to go back. The weather treated us cruelly or the Great Retreat might well have been forced under winter conditions. Thus the Somme, and with it the Ancre, brought about the Great Retreat (March, 1917).

(e) The Great Retreat brought about the Battle of Arras: a threat to its own right.

(f) Since the battle of Arras, there has been nothing but straightening out of the line, preparatory to the next big offensive. Successful operations at Messines and Wytschaete were for this purpose.

Thus the Somme was in no way an isolated operation, but the first link in a great and strong chain.

The objects of the battle were, to kill as many Germans as possible and to incapacitate and capture as many men as possible, to reconquer as much territory as possible and to gain the initiative and keep it. The possibilities were three in number: that we should break right thru the German line and force the enemy back into his own country, that we should break thru gradually before winter put a stop to field operations or that we should not be able to pierce the enemy's line at all.

There were many new features in the Somme, these were:

1. The battle was our first really large and determined offensive.

2. The enormous number of troops who took part in the battle between June and November.

3. Material difference in our artillery.

(a) The enormous masses used. (b) The extraordinary increase in caliber of guns used in field operations. (c) The marvelous progress in accuracy of our guns and howitzers of all kinds. (d) The practically unlimited supply of all kinds of ammunition. When ammunition was lacking it was a question of transport rather than ammunition. (e) The development and perfection of creeping barrages, moving forward with the attacking infantry at a perfectly regular pace, and a surprisingly short distance ahead of them. (f) The development in size and mobility of our trench mortars.

4. The great development of tactical bombing work, in the clearing of won ground and the taking of lesser points. Bombing tactics were elaborated and standardized to a high degree, and produced invaluable results.

5. Our mastery of the air.

6. The enormous development in the use of motor transport. Lorries were used in very large numbers, and probably much further forward in the offensive than had ever been done before.

7. Our use of gas, gas shells and flammenwerfer.

8. Our obtaining the mastery in mining.

9. The tanks.

The preparations for the battle were commenced many months beforehand and were gigantic. New railways had to be made, new roads to take motor transport and many old roads and bridges altered and repaired. Vast supplies of ammunition had to be brought up and stacked ready for use in the big dumps, and new sidings made for them. A large number of new batteries of large caliber had to be brought up and securly dug in position and protected, and arrangements made for their moves further forward. Water supply arrangements had to be made in great detail for an advance thru a practically waterless country, save for the damaged village wells. The engineer preparations were enormous, comprising in addition to the above, the accumulation and distribution of great quantities of engineer stores preparatory to an advance thru a devastated country.

An enormous amount of work had to be done in the training of troops for the assault.

The preliminary bombardment began about June 25. Zero was at 7:30 a. m. on July 1st. Sir Henry Rawlinson's Fourth Army attacked, and the First Phase began: that is, the taking of the first German system. The position was roughly as follows: 8th Corps opposite Serre, 10th Corps opposite Beaumont Hamel and Thiepval, 3rd Corps opposite La Boiselle, 15th Corps opposite Fricourt and Mametz, 13th Corps opposite Montauban.

The progress of the First Phase is as follows: July 1—8th and 10th Corps never in. 3rd Corps in as far as Contalmaison, but driven right out again by counterattacks. 15th Corps well in on both sides of Fricourt and in possession of Mametz. 13th Corps in possession of Montauban.

July 2—3rd Corps gets a footing in La Boiselle. 15th Corps takes Fricourt. 13th Corps consolidates and straightens front.

July 4—3rd Corps takes La Boiselle after four days

SOMME, Battle of

of terrific hand-to-hand fighting. 15th Corps takes the approaches to **Mametz Wood.**

July 4 and 5—Very heavy counterattacks byThiepval and north of it: all fruitless.

July 7—3rd Corps takes again and loses Contalmaison, and confronts 3rd Prussian Guard.

July 8—15th Corps gets most of Mametz Wood. 12th Corps gets into Trones Wood.

July 10—3rd Corps takes Contalmaison. 15th Corps progresses in Mametz Wood. 13th Corps repels continuous counterattacks in Trones Wood.

July 12—15th Corps gets the whole of Mametz Wood.

After ten days and nights of continuous fighting our troops completed the methodical capture of the whole of the enemy's first system of defense on a front of 14,000 yards. This system consisted of numerous and continuous lines of fire trenches extending to various depths of from 2000 to 4000 yards, and included five strongly fortified villages, numerous heavily wired and entrenched woods, and a large number of immensely strong redoubts. The capture of each of these trenches represented an operation of some importance, and the whole of them were in possession of the Allies.

This ended the first phase. On July 13 our right was well in whereas our left was stationary, limiting the breach, and the French were splendidly keeping pace on our right again.

The Second Phase lasted from the 14th of July until the 15th of September: namely, the capturing of the Second German Trench System. Zero was at 3:20 a. m. on July 14 and the French attacked in conjunction on our right. By night of July 14 the situation was as follows:

3rd Corps took Bazentin-le-Petit and its wood. 15th Corps took Bazentin-le-Grand and its wood, the ground between that and Longueval, and part of Longueval and Delville Wood. 13th Corps took the rest of Longueval and Delville Wood and cleared Trones Wood.

July 15—3rd Corps got right to the outskirts of Pozieres. 15th Corps, advancing, broke into the Third German System in High Wood.

July 16—15th Corps withdrew from Third German System in High Wood as the salient formed was too dangerous; but kept a secure footing in the Wood.

July 17—3rd Corps took Ovillers. Here came the real beginning of the Ancre Campaign, the Fifth Army coming into position immediately north of the Albert-Baupaume Road.

July 25—The Fifth Army (Sir Hubert Gough) took most of Pozieres.

July 26—Pozieres falls to the Fifth Army.

From now until Sept 15 was a period of preparation, and continued fighting to secure jumping-off positions from which to attack the Third German System. The general aspect was: Fourth Army straightening and consolidating for its next attack, advancing continually; Fifth Army pushing hard to catch up to Fourth and be ready for its own next attack, also advancing continually. To the south the French were always keeping pace.

Aug 23—15th Corps drives last enemy from Delville Wood.

Sept 3—Fifth Army advances considerably south and east of Thiepval and Mouquet Farm. 15th Corps gets most of Guichy. 14th Corps (in relief of 12th) gets Guillemont.

Sept 9—15th Corps gets rest of Guichy.

This finished the Second Phase of the Somme.

The Third Phase of the Somme was a brief one, the taking of the German's Third System on a selected front. It began on Sept 15, which was "Tank Day."

Sept 15—5th Army takes Martinpuich and Courcelotte. 3rd Corps takes High Wood. 15th Corps takes Flers. 14th Corps advances to conform to 15th.

Sept 25—15th Corps gets to the approaches to Guedecourt. 14th Corps gets to the approaches to Combles.

Sept 26—5th Army takes Thiepval. 15th Corps takes Guedecourt. 14th Corps (with French) takes Combles.

This finished the campaign of the Somme proper, altho minor advances were made from time to time thruout October to straighten out the line.

On Nov 13-17 the Ancre campaign had a brilliant finish in the taking of Beaumont Hamel and Beaucourt by the Fifth Army.

This last event closed the fighting in Picardy for the winter.

The results of the battle were as follows: the destruction of the enemy's forces in the field; the recapturing of territory and of the initiative in the west.

Many lessons were learned in the battle of the Somme and among them are the following:

1. Rigid discipline and consummate obedience to orders are, if possible, more vitally important than even was the case before. The more disciplined troops accomplish far more, fared better, and suffered far less, than the less disciplined ones.

2. The strictest attention to detail, even the minutest, is an essential to success in the field. It is a military platitude that far-reaching disorder can arise from a deliberate error in one detail. General principles come first, and detail afterward but neither can stand without the other.

3. The policy of lead beats the policy of drive. The former is costly in officers, but, when these are killed their men go on, following the lead of the next senior, because they are used to the policy. In the German army, where the officers and non-commissioned officers drive their men, loss or slackening of the drive produced the inclination to stop or surrender. Moreover, it is far easier to overdrive than to overlead a man.

4. On the Somme, the spirit of offensive was successfully inculcated into all ranks, even the lowest. Once an attack was launched it was followed up to the last degree. The result was that the enemy was never allowed any relaxation of the pressure, and could never form up successful counterattacks in any great degree. The successes due to this were universal, and the lesson is to teach all ranks, when they do go,

to go "all out," or rather, to continue to teach them so: and to hold all they get.

5. All ranks must have a fair knowledge of simple field works. In consolidation this is vital; many successes or failures to hold ground won were decided simply by the field work knowledge of the infantry concerned. It is merely an adaptation of the axiom that the Infantryman must be able to make his own cover. In practice, if well done, it reduces the casualties to an absolute minimum, and gives enormous confidence.

6. Always go for a definite and limited objective, and when you have got what you have been told to get, stay and consolidate it until told to go on. There were instances of quite large formations not heeding this, and getting involved and surrounded in consequence.

7. In launching an attack, the co-ordination of all arms must be worked out to the smallest detail. Under co-ordination too, include its result, co-operation. As far as practicable, each unit must know what its neighboring units are doing and are to do, as also its own supporting units and branches of the service, guns, planes, etc. Moreover, it is difficult to spend too much time in working out details of communication between the various troops.

8. There is only one way of getting a job done: whether it is the capturing of a country or the digging of a little hole.

On the Somme, officers and men alike from the highest to the lowest were given whatever they asked for to do their tasks, provided the requests were in all common sense. Then they were judged by results, and by results alone. There was no time for ineffectual good intentions.

The whole campaign was managed in a spirit of trust, and never in one of deliberate mistrust.

The eighth lesson condenses down to this: Trust your man and give him what he asks for. If you have trained him properly he will not betray your trust, neither will he ask for unnecessary things. Judge him by results alone; if he fails once, thru his own fault, dismiss him. But if you or yours have trained him properly he will not fail.

SPAIN

—Army—Cavalry

See

CAVALRY—INSTRUCTION AND TRAINING

CAVALRY—ORGANIZATION

—Army—Coast Artillery Service

See

COAST ARTILLERY—SPAIN

—Army—Field Artillery

See also

FIELD ARTILLERY—INSTRUCTION AND TRAINING—SPAIN

—Army—Organization

[General Outline of a Military Organization for Spain. By General Ricardo Burguete. *Mem. de Infantería.* Aug, '17. 6000 words.]

The active army should consist of the regular or permanent army, and a skeleton or reserve army. Both these forces should include only physically fit men between the ages of 21 and 26; losses to be replaced from depot reserves between the ages of 27 and 32. These two groups, recruited from the elite of the nation, would when united, constitute a mobile force to be quickly moved to any front where a powerful and vigorous offensive was demanded, while the territorial army fulfilled its mission of passive defense on all other fronts.

In time of peace the active army would consist of twenty divisions, each division capable of expansion on mobilization into an army corps of two divisions. These twenty army corps with necessary auxiliary forces would then be organized into ten field armies, one for each of the Military Departments of Spain. In time of peace the active army would have a strength of 270,000 men, to be expanded in war to 513,000, and this force should be mobilized annually for twenty days for grand maneuvers. The plan proposed is not an ideal one but could be put into effect at once with the materials available and would meet present needs.

While providing for a large increase over the present establishment the plan could be put into effect with an actual saving on the budget and with no increase in the official personnel.

Territorial Army

As the term implies the territorial forces would be localized, and because of the great variety of conditions existing in the different provinces it would not be practicable to have uniform organization thruout, or to attempt to have commands larger than battalions or half brigades.

The Territorial forces should include the following classes:

1. Those between the ages of 33 and 38 who have had service in the active army.
2. Those embraced in the one, two and three peseta categories.
3. Those lacking the vigor and aptitude for the strenuous work of the active army but who would still be useful for defensive purposes.
4. Those unfitted for military service but who could be employed in industries of a military character.

Those of the first class who have had six years of work in the active army would constitute the framework of the different classes of troops of the territorial army.

The Territorial forces should be commanded by the extra officers of the active army and reserve officers, by retired officers, and by officials created within the province. These forces should be thoroly organized in time of peace and should be assembled annually for target practice and field exercises. The Territorial Army should be considered as local and defensive in purpose, and the front to which it would be assigned in war should be definitely indicated and prepared during peace. The defensive works prepared by our engineer troops for instruction in the grand maneuvers should be made permanent and gradually built up into

SPAIN—Continued

strong defensive lines along our frontiers. These works should be assigned to the local territorial forces and they should be practised in occupying them.

The local territorial forces embraced within the front of operations of the active army would constitute a support, or movable base, establishing connection and guarding communication with the fixed base. Immediately behind this movable base and distributed according to the necessities of the campaign, should be the depot reserves for rapidly replacing losses in the active army.

Moroccan Troops

There should be a permanent force in Morocco of 45,000 men, 30,000 Peninsular troops and 15,000 native. This would be a real school of war, and service in Africa should be a strict requirement for promotion of officers. This garrison would be sufficient for ordinary police purposes and could be temporarily increased by Peninsular troops when major operations were to be undertaken.

In the effort hurriedly to build up a colonial army we have been led into many mistakes, and we should now begin at the bottom to lay the foundation of a real colonial force. This will of necessity be a slow process, and must rest upon a true appreciation of the Moroccan nature. His training and development must be along lines that will establish firm and enduring bonds of confidence and mutual interest.

In the present disorganized condition of Morocco a military government is necessary. The basis of organization for civil affairs should be the tribal groups now existing. For military purposes the armed natives of each fraction, or group, should be put under a native leader, and the several groups of the tribe united to form a somaten (armed party), under the leadership of a veteran native warrior selected by the group chiefs. Service in the Somaten should be obligatory for all natives having arms, and no others should be permitted to possess arms.

A fixed wage should be paid to the leaders, and the others should receive a small compensation when assembled for training or service. From the seven tribes now under control there could be organized in a few months 13,000 fighting men, and when we have secured control of the entire zone it is probable that we could organize 45,000 native troops. These, with 45,000 Peninsular troops, would constitute a force that would make our position across the straits impregnable.

[Information on Royal Military Reforms. By Muñoz-Cobo. *Memorial de Caballería*, May, '18. 1700 words.]

A reform under consideration divides Spain into eight districts, to which in all are assembled sixteen infantry divisions and three cavalry divisions, all of the first line. At the beginning of a campaign it falls upon the cavalry to cover the mobilization, and as cavalry cannot be improvised it would be better to have four divisions, one to every four of infantry. If creation of new regiments be impossible, then we must cut down to two regiments per brigade.

Each district is assigned personnel to form one reserve cavalry regiment. There are nine brigades specified, and twelve called for by the author. If the first, second, third and seventh districts, whose people are horsemen, each raise two regiments, that gives us one additional per brigade, which affiliation will greatly steady the reservists. This additional Division must include its cyclists and special troops.

There is a group of artillery with each division. This is insufficient; there should be a whole regiment.

The Remount Service is to be taken from under the General Staff and placed under the Minister of War. This service should be under a general officer, who should occupy his office for a long period of time. There should also be a lieut.-general of artillery charged with supervision of such manufactures as may in time of war be taken over by the government.

Not enough latitude is allowed in the selection of aides-de-camp.

The project will raise the salaries of all active officers, but makes no mention of generals of reserve. It will work out that a retired colonel will draw more than a reserve general. These generals should receive the pay of the next lower rank on the active list.

—History

See also

Great Britain—Army (Article: "The Irish Troops in the Service of Spain")

—Military Topography of

See also

Haxef—Marshes of

SPIES AND SPYING

See

Espionage

STAFF

—General Staff

See also

Argentina—Army (Article: "Reforms in the Argentine Army")

United States—Army—Staff

[High Command. By Maj. Carlos E. Villanueva. *Rev. del Círculo Militar*, June, '17. 7350 words.]

High command demands a partition of powers. All authority can not be placed in one man.

The principal characteristic of German organization is as follows: The Great General Staff handles everything concerning military strategy. It is united to the other powers of the government thru the war ministry, an administrative body.

The Minister of War is the voice of the Great General Staff in all cabinet and parliamentary meetings where military matters, which affect the finances of the country are discussed. In peace time, the minister of war's duty is to keep the national strategy and politics harmonized.

Chile has an organization similar to Germany's. Chile is more of a constitutional monarchy than a republic, consequently such a system flourishes. Altho Argentina has no such general staff and war ministry, she has more natural resources than Chile, and

once establishing a general staff, she can assure a lasting peace in her part of the continent.

General Bonnal truthfully says that a republican form of government and an independent general staff do not work together. For this reason, the military institutions of France have been inactive, after making a certain amount of progress.

The German General Staff is the Kaiser's mouthpiece. Many of his great prerogatives are only exercised thru the Great General Staff.

The attribution of great prerogatives to the general staff is not necessary. All that is wanted is a logical relation between military technicality and administration so as to keep the general staff from being forever lost.

It is difficult to lay down rules for the formation of a great general staff. These are taught by experience, but as long as the body can prepare the country for war, and be the instructor in the art of war, it will be successful. At present, the Great General Staff, or the Central General Staff, or the General Staff of the Army, as it has been variously called, is the only body in the Argentine military organization which is properly constituted to deal with the many and complex problems relating to war preparations. This work has been carried on inefficiently. The officers collecting information for the General Staff have failed to grasp the wishes of their superiors, so that the information that the General Staff has at present is half useless. After the great maneuvers of Entre Rios, the minister who had charge of strategic matters found himself under a mass of responsibilities which made him the target for public vindictiveness.

The general staff in time of peace must have absolute freedom of action in the preparation and instruction for war. It must be so organized that in war time it can maintain an invariable policy in spite of casualties and changes of personnel. The relatively simple control of subordinates in peace times becomes a very difficult matter in war time. The general staff must be prepared to meet this change, and to make its direct influence felt in every theatre of operation.

(The author concludes with a detailed comparison of the French and German General Staffs, dwelling especially on the following four points:

1. Initiative of Staff Officers.
2. Unity of Policy.
3. Organization.
4. Selection of Officers for the General Staff.)

[General Staff Duties. By Lt.-Col. J. F. Diaz, Chilean Army. *Revista del Ejército y Marina,* Dec, '17. 6000 words.]

(This article is based on the accepted ideas of general staff organization and procedure. The ideas of Von Clausewitz and Von Schillendorf seem to be predominant.

The subject is treated in a clear manner, beginning with the general conception of a general staff as expressed by the two above mentioned German authors.

The various duties of the general staff in time of war are then discussed and these duties are compared with its peace time functions.

The organization of the Chilean general staff is taken up and its duties and work explained, after which the author explains the *raison d'être* and necessity for staff organizations with bodies of troops and their resultant duties.

The relations which should, and do exist, between the general staff and the war ministry, or political side of the government, are mentioned, and in addition some general ideas on the organization and procedure of the War College are laid down.)

[The Historical Section in a General Staff. By Lieut.-Col. P. Azan. *Military Historian and Economist,* Apr, '18. 1700 words.]

Every staff and every body of troops has archives. Some of the matter recorded is of interest, the rest not. In the French army, these papers are turned in to the archives of the Ministry of War, where they are classified as administrative archives and historical archives. The latter are of far greater importance, and contain the correspondence, documents concerning the history of troop units, journals of operation, etc. Each of these two sections of the archives has a chief and an expert civilian personnel.

The function of the Historical Section of the General Staff is not the classifying, but the studying of these documents. The personnel of this section is military.

Assuming that the study of history, including contemporaneous nistory, is the foundation of military science, it follows that the personnel of the historical section must be selected with the greatest care, for upon it rests the responsibility for gathering data of the utmost importance in establishing the theory to be put into effect for the army.

In the French system, there are three centers of theory: (1) the Historical Section of the General Staff; (2) a group in the General Staff known as the center of advanced military studies; and (3) the Ecole Supérieure de Guerre. It is necessary for the Chief of the General Staff to effect a complete co-ordination. Any theory must rest on precise observation, and military theory must include observation of recent as well as past events.

In the French organization, in time of peace all information concerning foreign armies is centralized in the Second Section of the General Staff, and all reports of missions and attachés sent to follow the operations of foreign armies go to it. In recent years, all means of information that come under the head of spying have been withdrawn from the Second Section and entrusted to the Police Department, thus depriving the Second Section of means of information of which the Germans have made very great use and development.

In time of war, the Second Section of the General Headquarters, which concentrates all information concerning the enemy, and the Second Section of Armies and Army Corps, make use of all information in forming their estimates.

The Historical Section cannot collaborate usefully in time of war in perfecting a theory of war, because the documents must remain at General Headquarters,

SEARCHLIGHTS—Continued

and the work must be done there by the combined efforts of different sections—notably the Second Section, which handles information as to positions and methods of the enemy; and the Third Section, which deals with the operations and instruction of the troops.

The Historical Section has, nevertheless, an important war time function. The personnel is composed then mostly of over-age and disabled officers, yet with military experience which makes them valuable sources of advice in the classification and preservation of archives. One of the important tasks is the selection of documents to be preserved. The selection of those to be destroyed calls for a combination of military, literary, and historical judgment very difficult to secure. (An instance of the destruction of valuable documents is related.)

In America great care is exercised with respect to documents, possibly because the records have not yet become too voluminous. Yet questions of the storage and classification of documents will inevitably arise in connection with the present war. This points to the demand for an organization similar to the Historical Section of the French General Staff.

[Functioning of General Staffs in the Field. By Major F. V. Portuondo. *Revista del Ejército y Marina,* Mar-Apr, '18. 4500 words]

After discussing the necessity, personnel, and organization of a General Staff, the author states the following field duties of this body:

1. To prepare the elementary points upon which the chief makes his decision.
2. To transform these decisions into orders and instructions.
3. To complete the instructions and orders by attending to all the details that the chief would not attend to himself.
4. To assure the transmission of the completed orders and instructions to the proper officers and in case of necessity to supervise and control the execution of these orders.

The General Staff officers will perform exterior and interior duties.

The exterior duties will be in the nature of inspection trips to all the different organizations controlled by the chief or under his direction, and will consist in reconnaissance and patrol work to determine enemy positions; strength, etc. Besides these outside duties, staff officers will often accompany troops or columns to see that they reach the proper point, at the proper time and in the correct formation which the situation demands. Staff officers will be used as liaison agents, and as dispatch bearers.

The interior service of Staff officers is divided into three divisions as follows:

1. Personnel and matériel.
2. Political information and action.
3. Operations and movements.

(The above organization would be applicable only to the armed force of a country with no settled political policy.—Ed.)

Duties of the first division (Personnel and matériel): The following subjects come under the jurisdiction of the first section.

Organization, effectives, positions, evacuation and replacements, changes, remounts, promotions, police, discipline, munitions supplies of all sorts, transportation, and official communications.

The situation of forces is analyzed every day and the daily report rendered to the chief; every fifth day a general report is made up in which the condition of men and animals is stated in detail.

The second division keeps informed on the political situation, maintains the Intelligence Service, and is in charge of all topographical work.

The third division locates troops, moves them, puts them in battle and superintends the combat. It issues combat orders, makes reconnaissances and prepares the daily reports on operations and position of combatants.

The author discusses the various methods in which these three divisions or sections of the General Staff can install themselves, prepare and maintain correspondence files, and in general the office routine of each division.

STEAM CROSSINGS

See

River crossings

STRATEGY

See also

Camouflage—Strategic
European war—Military lessons of the
Fortifications—Permanent—Strategic value of
Railroads—Strategic
Tactics

[Position and Maneuver War. By Col. K. Egli. *Schweiz. Monatschrift aller Waffen,* Nov, '17. 1550 words.]

The modifications of the aspect of combat in the present war have caused many to believe that the fundamental principles of warfare, which have endured for thousands of years, have suffered deep-seated alterations. Many phases of the position war seem to overthrow the lessons of all previous campaigns, and principles are deduced from single instances which turn upside down things which we, a short time ago, regarded as fixed principles of warfare. This condition is inseparable from all wars. For example, from the Russo-Japanese war arose a school of thought which found salvation only in the thin firing line, with practically no reserves. Artillery fire was regarded with sovereign contempt, and dissenters were burned as military heretics. All of that has disappeared without leaving a trace. A few years ago our divisions deployed on a ten kilometer front, hoping thereby to conform to the effect of modern weapons. To-day six, eight, and ten divisions fight in deep formations on a similar front. The Japanese could ignore the law of the reserve only in the face of an enemy who, like the Russians, maintained the passive defensive. He who is unable to probe effects to their deepest

causes is liable to generalize from phases of war which are really the results of a special situation. The danger of straying on a tangent becomes the greater in proportion as single facts occupy the attention, as the numbers of the troops, the extent of the theater of war, the duration of hostilities, or the isolated facts which the critic has personally observed.

A search of works on tactics heretofore published will fail to reveal any statement of the conditions of maneuver and position war. It was unquestioned that always and under all circumstances the decision must be sought in maneuver and attack. Defense of a position was a necessary measure taken only when nothing else was possible. Authorities went so far as to maintain that the belligerent who was not in position to attack was proceeding to certain defeat.

The early incidents of the world war corresponded to this view. In the West both sides attacked. The French moved forward in Alsace, in Lorraine, and in Belgium. The forces were apportioned on the whole theater for this purpose, but no French general thought it more appropriate to await the enemy in fortified places in order to spare forces for *the* attack which should bring a decision. The French commanders in the Ardennes and on the Sambre still issued attack orders when the battle was already lost and when nothing remained to be done but to free themselves from the enemy and to seek, by retreat, to restore in some degree the lost advantage. On the German side also salvation was sought in general attack; only they understood better how to co-ordinate the forces and to thwart the plans of the enemy by a powerful and unified advance of the main forces in Belgium. The result of this first encounter of strong forces was a war of maneuver which brought the Germans nearly to Paris. There the advance came to an end, not so much from the resistance of the Allied forces, as from the consumption of strength which is inseparable from every maneuver, and which is greater in proportion to the resistance to be overcome. Joffre had the correct feeling at the Marne that the German invasion must end, at least temporarily, and gave his orders accordingly.

The following French attack was well initiated, but was carried out by troops who had not developed for the task. In consequence the German position was already in preparation when the Germans retreated to the Aisne. The German retreat was not due to tactical necessity but to operative conditions whose nature is still unknown. The Germans did not then intend to change to a long position war. On the contrary, they wished as quickly as possible to resume the forward movement, and soon sought to turn the northwest wing of the French. Since the latter had the same intention, maneuvers and battles followed which have been designated as the "Race to the Sea." When this effort to escape a position war ended at the sea, the Allies began attempts to break thru, which still continue. Not every attack on the west front can be considered as an attempt to break thru; but since the first vain attempts of the French and English to penetrate the German positions, powerful attacks have been launched in Champagne, on the Aisne, in Artois, and in Flanders, with the open intention not only of seizing the German positions, but also of creating a breach in the German line, thru which armies could drive and then change to maneuver war. The Germans also made such an attempt at Verdun in 1916, which, however, was prematurely halted and which could not then be resumed. To-day we are confronted by the fact that in the western theater both sides are bound fast to their trenches, since nearly all attempts to resume maneuver war have failed. Nevertheless the maintenance of the battle front in one position is not an end in itself, but a necessary evil from which both sides wish to extricate themselves as soon as possible; for to-day the fundamental rule still obtains that only in maneuver and attack can decisive success be won.

Events have taken a somewhat different course in the East, but there also the effort has been the same. The movements of the Russian army were based on the plan that the Russian armies should move like steam rollers on the enemy capitals and thus overwhelm all resistance. The Russian command believed it possessed such superiority of numbers that the effort must succeed, but overlooked the fact that their machine was built of material which would be crushed and pulverized by impact with the enemy. The first encounters in East Prussia, south Poland, and Galicia were classic examples of maneuver war, and we see in the autumn and winter of 1914, on both sides, always the effort to change to maneuver and offensive. In the winter battles in the Carpathians the Russians consumed so much strength in their efforts to penetrate the Hungarian plain that the Teutons succeeded in breaking thru at Gorlice. The result of this penetration on a relatively small front was the great offensive which drove the Russians back to Russia. Only in 1916 were they able, because of the masses at their disposal, to resume the offensive. In June their first advance in Volhynia and East Galicia succeeded, but they lacked the necessary strength and mobility to follow up their bloodily won advantage. The Russian leaders stopped at a point where they should have been able by a quick maneuver to so widen the existing breach in the hostile position that the resistance must have collapsed. In 1917 the Russians again attempted to break thru in East Galicia, but with insufficient means, and when then comparatively weak Teuton forces assumed the offensive, there was no halt until the Russian-Rumanian boundary was reached.

From this short survey it ought to be sufficiently clear that even to-day the position war is not the chief method of combat, but only an expedient of necessity. Each army command is striving to move from the trenches to the offensive and to large scale maneuvers as soon as possible. The new war matériel could not and can not alter this in any way.

[The Strategical Teaching of the French General Staff. By Col. F. M. Maude, C.B. *Army & Navy Gazette*, July 13, '18. 2400 words.]

The appointment of General Foch as Generalissimo of the Allied Armies on the Western Front has brought the strategical doctrines of the French General Staff, of which he is the chief exponent, most prominently

STAFF—Continued

before the public. To facilitate co-operation it will be useful to explain this teaching and how it came into existence.

General Foch did not originate or create these ideas; they were the result of investigations into the causes of defeat of the French Armies in 1870. The military board found that all ranks of the army had been loyal, etc., and the problem resolved itself into finding out by what process Napoleon had succeeded while the French of 1870 had failed.

To solve this problem the French Staff enlarged the Bureau of Military History and placed at its disposal the best critical intellects the army could supply for sifting out and dealing with the data relating to the Napoleonic campaigns. Napoleon's correspondence, as published by Napoleon III, was supplemented by the replies of the Marshals and the action taken by them as influenced by all the conditions existing at the moment of their receipt.

It was a colossal literary undertaking and is not finished yet, but soon a few men of peculiar mental endowment began to discover a red thread of consecutive design in all the letters of the Emperor to his marshals, beginning with the year 1806. The essential honor of the discovery is attributed to the late Captain Gilbert of the French Engineers, but if the minds of the many of his colleagues had not been attuned to the idea it is improbable that any consequences would have followed.

Briefly, the arguments run as follows: Critically examined, the campaign of Ulm, 1805, the first in which Napoleon commanded an army of many corps, was found to have been a narrow escape from disaster.. Altho he crossed the Rhine with 240,000 men, losing 40,000 stragglers, he was able to bring into action only 17,000 men on the first day of the critical battle and was saved from defeat in detail only by a lucky topographical incident in the ground which neither side had foreseen.

The bulletins of the *Moniteur* of the time gave a different idea which was taught prior to 1870. What struck the new students was that, despite the brilliant success of this campaign, Napoleon never repeated the procedure he had then adopted. Further, compared to 10 per cent in 1805, Napoleon in subsequent campaigns always arranged to bring 60 to 95 per cent of his effectives on to the battlefield. As far as weather and daylight permitted, these troops were always ready to strike home at the critical period of the day, and this notwithstanding slackness in execution and misunderstanding of orders, etc.

It also struck them that the German campaigns of Sadowa, Metz, and Sedan had been designed in exact conformity with the Napoleonic method of 1805, and the conviction gradually arose that somewhere everyone had missed an essential point in the working of the Emperor's mind which would, when discovered, explain the divergence between the results of his first and his later campaigns.

Captain Gilbert found the key in two letters of the Emperor, written on the eve of the campaign of Jena, to Soult and to the King of Westphalia respectively. In these letters he frankly admitted his general ignorance of the positions or plans of the enemy and announced his intention of marching direct for the line of junction between their two armies with his own forces grouped at the angles of a rectangular lozenge—"at the head of a battalion square of 200,000 men," to use his own words, and it is probable that this illustrative phrase prevented true understanding of what was really in his mind until 1890, for whereas the average soldier visualizes a battalion square as a purely stationary defensive organization. Napoleon saw a moving rectangle capable of forming a fighting front in any direction and wheeling on any angle as a pivot. The first group to encounter the enemy should attack with all vigor and hold the enemy until the rest of the army came up—thrown to the right or left as Napoleon decided. This main mass thus took the enemy at a decided disadvantage, committed to the action as he was. This was only the general idea of the Emperor, who altered his plan to suit the case. But the essential point of difference of this idea and that of the Ulm so generally followed, is that in 1805, he aimed to surround a target which did not stand still. In his later campaigns he held his object immobile while maneuvering. Thus, at Gravelotte, Bazaine foiled the plans of the Germans by halting there, when the Germans expected him to retire. Here Moltke followed Napoleon's plan before Ulm and brought only 64,000 out of 260,000 into action. A German disaster was barely averted.

It was mainly on the similarity between these two maneuvers, Ulm and Metz, that General Bonnal, head of the French General Staff, at the time Captain Gilbert made his first discovery, built up the whole doctrine of the general advance guard forming the fixed point on which the decisive blow of the reserves was to pivot and General Foch—then Lt.-Col.—was its ablest exponent. He has written two books: "Les Principes de la Guerre" and "La Manœuvre pour la Bataille."

The same principle holds to-day, and when Gen. Foch sees fit we shall see a repetition of Napoleonic strategy on a grand scale.

[What is Meant by Strategy? *Kungl. Krigsvetenskaps-Akademiens Tidskrift,* Feb, '18. 3300 words.]

This question has been answered differently by different authors, without any of them having succeeded in finding a definition which is able to cover completely this idea, a lack in the science of war, which perhaps does not mean anything in practice. The best answer to the question is really the excellent accomplishments of Hindenburg's war operations in the world war.

The operations in East Prussia, the retreat in Poland, the victorious moving forward on a 100-mile front 20 to 30 miles to the east of the line Duna-Pinsk-Strypa, the conquest of Serbia, Montenegro and Wallachia, the islands Osel and Dago, and latest, the rolling up in four days of the Isonzo front thru which the successes so dearly bought by the Italians during two and one-half years' fighting were destroyed, is strategy in its grandest aspect. It has shown how to

resist and to defeat hostile forces many times more numerous than themselves.

Strategy as a science did not come into light until the latter part of the 18th and in the first half of the 19th century, when one military author after another began writing his own experiences on war, and classified the basic principles founded on the history of war and the operations of famous generals.

The most famous of these authors, the founders of the science of strategy, were the Generals Lloyd, Clausewitz, and Jomini, of which the first was English, the second Prussian, and the third Swiss. All three had, according to the custom of their time, acquired war experience thru participating in the wars of foreign armies. From the same time we have strategical works by Frederick the Second, H. D. von Bülow, and Archduke Karl of Austria.

In 1850 the German-born Swiss Colonel W. Rustow wrote his book on the art of leadership, and about 20 years later the Russian General Leer published his positive strategy with theoretical standards for different operations.

From later times we have numerous well-known names in strategic literature, such as Moltke, Blume, Verdy du Vernois, Schlichting, Goltz, Derrecagaix, Lewal, Horsetsky. In our own country we have two valuable strategical works published by the Generals J. P. Lefrén and C. O. Nordensvan. All these authors have to a greater or less extent treated the different factors of war operations.

Lloyd and some others have included the moral element and the effect of the forms of government on the conduct of the war. Clausewitz has absorbed himself in the spirit of war and its different aims from the point of view of philosophy and with real German thoroness. Jomini has emphasized the advantages of operations on inner lines and against the decisive point.

This strategical science has thus treated all the factors which might influence the conduct of war. Several of these factors, such as military psychology, geography, topography, military management, the art of fortification, etc., in themselves might be considered special sciences, hence strategy in its entirety has been called the "science of war sciences."

Napoleon, master of the art of war, did not write any book on strategy. He sometimes called strategy higher tactics, sometimes art of war, but his memoirs contain more of strategical value than long treatises on the subject.

The basic strategical principles are the same for both army and navy. Only one author, Admiral Bouet-Wollaumez, the commander of the French Baltic fleet (1870) considered strategy of small importance for naval operations, but this has justly been refuted by his naval colleagues.

A great step forward was taken in 1899 and 1905 by the German Lieutenant General von Janson thru his works on the strategic and tactical co-operation between army and navy. The last book contained lessons from the Russo-Japanese war of 1904-05. He shows how intense this co-operation was with the Japanese during this war. This co-operation had its origin in the well-chosen commanders, and above all in the unselfishness and competence with which the representatives of the land and naval defense always were prepared to aid each other. Vice Admiral Aleksejevs (Alexieff) was the head of the Russian army and navy, but in spite of the unity of command there was no co-operation on account of incompetence, lack of foresight and goodwill on the part of his subordinates.

The author draws attention to the importance of co-operation, and while he does not claim that his work has treated this question exhaustively, he urges careful attention to this subject.

In our country General Major C. M. Fallenius published, in 1906, a creditable work based on the opinions of von Janson adapted to Swedish circumstances.

After the world war another problem will present itself to be treated scientifically, namely that of aeronautics. Its field stretches between land and sea and makes it a link between its elder sisters of arms in both land and sea operations. But science has not said its last word in the matter of war operations.

First and last, the general basic strategical principles crystallized from the art of famous leaders must never be considered as binding, positive rules. The knowledge of them is certainly necessary for an educated officer, but they are valuable only when they can be adapted to situations and changed to answer the exigencies of our times. Strategy and tactics are intimately connected with each other. War science has not drawn any line between them.

The operations which are conducted outside the territory which can be reached by hostile guns may be called strategy. Those operations which are conducted within the reach of the guns of the enemy may be called tactics. Thus strategy represents the extensive operations, tactics the details.

To tactical war preparations belong the training of forces, armament, and equipment, or in short, everything which can further the fighting efficiency and prepare the maneuvers and co-operation within range of enemy fire, and also the training of excellent tactical leaders. To strategical war preparations belong the planning of the defense in its greater phases, certain measures to strengthen the efficiency and co-operation of the higher units and the training of excellent strategical leaders. One branch is not less important than the other. They ought not to be separated because they complete each other, even if strategy according to its nature seems more important. Only hand in hand are they able to gain lasting successes in the field.

To return to the art of leadership, its aim is to gain a larger or smaller object in the war with available forces and the smallest possible casualties and loss of material.

Regarding the defen e of the existence of Sweden the issue is to fight for the great aim of the expulsion of the enemy.

Thru the progress of technique the problems of the leaders have been both facilitated and made more difficult—facilitated thru the possibility of leading widely separated groups of troops within extensive territories and indifferent elements, made more difficult thru the necessity for the leaders to extend their knowledge in

STAFF—Continued

order to establish the co-operation of the different arms. This progress is very important for the defense of our extensive territories. Just as the commander of an army division disposes of the three kinds of troops, infantry, cavalry and artillery in a tactical respect, so will hereafter an overcommander strategically lead armies, navy and airplane squadrons. The tactical trio corresponds to an equal strategical trio within the field of co-operation.

In the world war we have newly seen how the airplanes, in the conquest of Osel and Dago, discovered the grouping of the Russian forces on the islands, how the German fleet forced its way thru the mine fields, silenced the fire from the coast batteries, protected the landing of the army, and how the hostile resistance was quickly broken thru the intimate co-operation of the three arms. This brought, besides the occupation of the islands, the strategical advantage of securing the left flank of the German army at the Bay of Riga and conserving the liberty of movement to the eastward of joint operations between army and navy in the future.

The defense of the Duna line before Riga fell into the hands of the Germans is an example of the cooperation of different arms on the strategical defensive—a case more likely to occur in our country. The Russian army defended the fortified river line between the sea and Dunaburg, with especially strong fortified points at Dunamunde, Riga, Jakobstadt and Dunaburg, and was protected on the right flank by the Russian navy in the Bay of Riga and protected from observation by their air fleet which knew about the activity of the Germans. Also here was a co-operative triumvirate in the defense, tho the aim in this case was negative instead of positive, parrying instead of attacking.

In the defense of our country—especially in summer time against an invasion from the sea—there are numerous occasions for co-operation between the different arms, from which certain lessons ought to be drawn regarding the strategical education and organization of the higher command. The tactical procedure within an army division ought to serve as model for the strategical procedure within the army.

The factors of tactical application in practice for the command of a division are infantry brigades, cavalry, artillery, engineers, and army service. The corresponding factors of a larger strategical maneuver (on the map and partly in the field) for the higher command are armies, air fleet, navy, fortifications, and lines of communication.

Really valuable strategical co-operation will, however, not take place until a permanent representative is placed immediately below the highest command. The army division will not be a useful tactical fighting unit until the commander of it controls all of the different kinds of troops necessary for such unit. Our military strength will not become a strategical unity in the defense until it gets a real joint leadership, founded in peace on the same principles as must rule in war.

The art of leadership alone certainly cannot perform any miracles in war. The leader must have good and convenient tools for the execution of his art and the ability to use them correctly. Too little attention may have been given to developing a good leader in a co-operative respect for the defense of the existence of our country.

Our extensive war history gives many examples of the co-operation between army and navy. In almost all of our wars during the last 200 years, such cooperation has existed. The result has been different according to the quality of leadership. The expedition to the Oder Islands (1759) under Fersen led to the desired result. A great strategical effect was obtained in the campaign against Norway in 1814 under good leadership, but the loss of Finland (1742) and the jeopardy of our whole military force (1790) was caused by bad understanding between our higher commanders and lack of foresight in execution.

The conditions for good co-operation are now somewhat different thru the changed military-political situation of Sweden, technical progress, and the development of the art of war. The question is whether we have fully attended to the consequences thereof in our strategical war preparations.

The world war has taught us, among other things, that changes in the higher command are considerable during a long war. There is scarcely one of the warring powers which has not changed one or more times the high commanders, chiefs of staff, and chiefs of many higher units. The consequence of this ought to be that in peace all the higher commanders ought to have a general strategical education—especially in a country with a small military force, with a defensive problem—and not the portioning out of some small strategical exercises which would scarcely be sufficient for the different ranks and commands at the breaking out of a war.

In the defense of a country, the strategical field is almost the only one in which the military forces of a smaller country might obtain absolute superiority over those of a larger country. We ought to assure this means of strengthening our defense, especially as the expense is very inconsiderable.

STREAM CROSSINGS

See
River crossings

STRETCHERS

[New Uses for the Army Litter. *Military Surgeon*, Jan, '18. 1200 words. Illustrations.]

(A description of an ingenious method for using the regulation hand litter as a splint to meet effectually on the field all the indication for the treatment of any fracture, especially of the extremities. The patient is completely immobilized, and the litter may be turned in any direction without harm. The article does not admit of ready digesting, and the photographic illustrations are necessary to a full understanding of the matter. It should be consulted in the original.)

SUBMARINES

[German Submarines—Information on. By "A." *Memorial de Artillería,* Mar, '18. From *La Nature.* 700 words.]

German submarines operate either singly or in grohps, according to the circumstances.

While in repose the submarine remains on the bottom of the sea, if depth will permit, and attempts to detect ships which approach. Once a ship is detected, the submarine rises so that periscopic observation may be taken; it then maneuvers according to the observations. If the depth is so great that the submarine cannot rest on the bottom, it submerges to a certain depth at which it is invisible from the surface and maintains this depth. In order to do this it must travel at from two to three knots per hour. The maximum depth attainable is 60 meters. Normal depth is from 15 to 30 meters.

Submarines return to home ports every 30 or 35 days. The range of action of these boats is between 5000 and 8000 miles, and they can travel at an average rate of between 10 and 11 knots per hour.

Submarines probably have hidden bases in Ireland, Greenland, and Iceland. Submarine bases have been established for oil and gas and other necessities.

Submarines can submerge in three or four minutes, and when traveling close to the surface they can rise take an observation and submerge in 15 to 30 seconds. The submarine can follow a course in the form of a vertical sinusoid—rising and descending at will.

Modern submarines carry three or four periscopes. Torpedoes are usually regulated to travel at a depth creased. Submarines employ the gyroscopic compass. of three meters. If the sea is calm this can be in-

—Defense Against

See also

Convoys and convoyance

[Passive Countering of the Submarine Menace: A Résumé. By Capt. C. S. Goldingham, R.M.L.I. *United Service Mag.,* Nov, '17. 3300 words.]

Now that the submarine menace has proved to be exaggerated and the German hopes ill-founded, one may review calmly the methods by which the evil has been met up to date and the means projected for rendering the position still more secure. Of active methods—the destruction of submarines—it is perhaps unwise to speak, but it is by passive, no less than by active means, that success in combatting the evil has been achieved.

The first step to be taken is the Government control of all shipping, including the restriction of imports, elimination of unnecessary cargoes, mapping out of routes and assigning ports of discharge. Any means which tends to increase the number of voyages in a given time is valuable. Under this heading too comes the convoying of merchant vessels and instructions in the methods of avoiding and meeting attack.

The replacement of vessels sunk by submarines is proceeding rapidly. The urgency of speeding up construction has been fully recognized. All-wood ships are impossible, however. Seasoned timber does not exist in sufficient quantities. Wood may be used to advantage in connection with steel framework but not for the whole vessel. Reinforced concrete has been suggested as a possible substitute for steel in ship construction and should prove satisfactory if properly used.

One may say that it is impossible to fit merchant vessels with any torpedo-stopping device suspended from booms for use at sea. Pads or tanks have been used with success, particularly the former, tho their effect on the speed of the ordinary slow tramp steamer is serious. Probably the best protection is an efficient system of bulkheads.

[Anti-Submarine Devices. By Enrique de Montero. *Mem. de Ingenieros,* Jan, '18. 5000 words.]

The marked success of the submarines in the present war, due chiefly to their facility in escaping observation by submersion, has called for the most intense efforts to find some successful method of meeting the situation, especially on the part of England and the United States. In both these countries the best minds have been placed on the task of finding some practical method of attack and defense, as well as their detection while submerged at some distance away.

For the detection of these submarines, the American electrical engineer, William Dubilier, has designed a system of stations along the shore which are connected with receiving apparatus submerged at a distance from the shore. This receiving apparatus consists of microphones which are connected to a telephone receiving station on shore. At the beginning it was necessary for Mr. Dubilier to solve a great number of electrical and sound problems of which we have no data before he was able to distinguish between the characteristic sounds of the submarine machinery used while submerged and the sounds of the ordinary screw propellor. After he had solved these problems he found that the range of his apparatus was too limited, being effective up to only a few miles from shore. He overcame this difficulty by means of an amplifier so that he is now said to be able to work up to a distance of 50 miles from shore.

Naturally, few details of this apparatus are open to the public, on account of the value which they would have for the Germans, but it is known that he uses a number of microphones submerged to a depth of 10 to 15 meters and at a considerable distance from shore. These are so arranged that each one indicates sound waves from only one direction. The operator on shore can listen in on each of these separately, so that he can locate the direction of the submarine rather accurately. By carefully noting the variations in the intensity of the sounds, the operator is also able to determine the direction of motion of the submarine. Unfortunately, this apparatus is so delicate and must be kept in such absolute adjustment that it cannot be used on board ship. It is reported, however, that the English, Scotch, Irish and French coasts are well provided with these stations, which are equipped with wireless for communication with the patrol boats.

Several efforts have been made to locate these sub-

SUBMARRINES—Continued

marines by the aid of powerful electro-magnets suspended below the surface of the water, and also by artificial illumination of the water at considerable depths. but these ideas have been abandoned because of their lack of practical success.

One very successful means of locating these boats is by the aid of large nets of iron or steel wire with large mesh, suspended in a vertical position by means of floats and connected to buoys. When a submarine becomes fouled with one of these nets the motion of the buoy makes it very easy for the patrol boats to locate the submarine. As soon as located, these light, fast patrol boats assemble for the destruction of the submarine by means of depth bombs or by gun fire if the submarine rises to the surface. The small cost and light weight of these nets make it possible to use them in large numbers so as to cover enormous areas of sea; France has in use at least 5000 nets and England a much larger number. Italy began the use of these nets later than the other of the allies, but already has a number about equal to that in use by France.

The value of these nets has increased lately, on account of the fact that the Germans and Austrians have almost neutralized the value of the sound detectors by improvements which practically eliminate the sound waves caused by the machinery of the submarines.

The chief defenses of harbors against submarines are mine fields and systems of nets. Both of these have been passed by submarines during the course of the war, but they constitute a formidable defense. Both contact and controlled mines are employed.

One scheme which is used with controlled mines for harbor defense is to lay the mines out in a checkerboard fashion from 15 to 20 meters below the surface. Each mine is provided with a microphone which will report the sound of a submarine in its immediate vicinity. On shore is a small board on which each mine is represented, and a system of small light bulbs which show by their lighting the presence of a submarine in the vicinity of the corresponding mine. The mine is then fired at the discretion of the operator. It is also possible to trace the course of a submarine under the mine field by watching these lights.

Lines of nets have been placed to defend the entrances of many harbors by several nations, and several submarines have been captured by their aid. However, their use is limited for this purpose to places where the water is comparatively shallow and the anchorage is good, so that by now the submarines should know the places where they are likely to be found and their value at the present time is largely passive defense rather than an active danger to the submarines.

Attack by surface vessels. From the beginning of the war the English have understood the necessity of organization for the attack of the submarines. For this purpose they armed a great number of small, fast boats. As the enemy submarines in 1914 were few in number, and their size, speed and radius of action were limited, this was considered a sufficient precaution.

It was not long before the enemy submarines appeared in much greater numbers, of greater size, offensive power, and radius of action. To meet this new menace civilian societies were organized under the charge of naval officers, and as the English are great sportsmen this was given the nature of a sport. This fact, combined with the money rewards offered for the destruction of submarines, caused the organization of a great number of civilian societies. These were divided into patrols, or units assigned to various sea ports, equipped with wireless for communication. The methods followed by these patrols are to split into two parts on leaving port so as to be able to cover their entire area with the aid of hydroplanes.

As soon as a submarine is located, it is attacked by the chaser unless it is submerged. In this case the entire division of the patrol is notified and careful watch is kept until the submarine finally has to emerge. As soon as this happens the submarine is attacked by rapid fire guns from the nearest chaser. The greater speed of the chaser enables this to be done.

Before the necessity of chasers designed exclusively for anti-submarine work, there were designed in America three types of these boats, on data supplied by the American Navy Department; of varying speed, size, and radius of action. In addition to the work described above, these boats are used for patrolling about war vessels of greater size, being organized and equipped according to the nature of the service.

The French have used these chasers in a manner very similar to that of the English, so that the ports and coastal waters of the belligerent nations are very well supplied with these small boats.

Not only England, France, and the United States have developed anti-submarine devices, but also Russia and Italy. The Italians, in addition, have made extensive use of depth bombs of a considerable effective radius when detonated below the surface of the water.

Aerial Attacks. The aerial service is considered especially advantageous for anti-submarine work, both on account of the great field of view from overhead and because the submarines can be seen while submerged if the observer is directly over them. This is especially true on days when the air is clear and the sea smooth. Under very favorable circumstances this has been done up to 25 or 30 meters depth, but ordinarily the aviator can count on locating the submarine before he is seen from it, then notifying the chasers.

All the maritime nations now at war are supplied with hydroplane bases along their coasts, conveniently located for exploration and communication. Also the patrols are supplied with hydroplanes, generally two-seater biplanes carrying bombs for attacking the submarines and wireless sets for communicating with the mother boats. These mother boats are supplied with ingenious devices for launching and picking up these hydroplanes.

The submarines have been very vigorously attacked during this war, thus greatly decreasing their efficiency. To give an idea of this fact, it is stated that in the course of a single month along the French coast there occurred 34 combats with chasers, 8 with hydroplanes, and 3 with land batteries. It is believed that the Central powers are using not more than 500 submarines,

while the number of chasers actually in use must be at least eight times as many, in addition to the 30,000 nets and an almost unlimited number of other devices for combating the submarines. Under these conditions, it must be admitted that the submarines have shown the results of good management as indicated by the successes which they have attained in the numbers of boats of all classes sunk by them.

[The War at Sea. By a Naval Officer. *Army & Navy Gazette*, Aug 10' 18. 1300 words.]

Among the anti-submarine measures initiated and encouraged by Mr. Churchill and Lord Fisher were the "Q" boats, the mystery attaching to which has now been dispelled by Sir Eric Geddes. The mystery would not be explained if the Germans had not learned by dire experience the nature of the ruse and the Admiralty still has a few tricks left.

The "Q" boat may be briefly defined as a decoy. By reason of the unscrupulous conduct of the submarine commanders in sinking vessels without notice, etc., the British seamen left no stone unturned to frustrate them. Thus the British evolved the idea of a decoy. At first it was only necessary to place one or more guns of sufficient caliber to penetrate the skin of the submarine on any description of merchant ship and to conceal their presence. The submarine, bent on destruction of its quarry came within range and was put down. Later subtlety and invention were necessary both to hide the real character of the "Q" boat and to inveigle the submarine within decisive range of her guns. Thus in the case of the *Baralong* which sank the murderers of the *Arabic's* crew and passengers, the Germans complained that there was nothing to indicate the warlike character of the *Baralong* and that fire was suddenly opened from an armament which up to that time had been hidden by screens. To throw them off their guard by such a device they termed treachery. Truly, as Mr. Balfour said at the time, any *ruse de guerre* employed by the Germans is considered by them to be legitimate, but everything of the kind becomes illegitimate when practised against Germans. Several V.C.'s have been awarded for gallant work in the "Q" boat service. Altho the Germans squealed, they were not above copying the trick and disguising their raiders as merchantmen. Their U-boats have been known to put out sails to disguise themselves.

—Germany

[Note. *Army & Navy Jour.*, Mar 9, '18. 327 words.]

It has been established beyond question that certain of the new German submarines now engaged in commerce destruction are large enough to merit the title of cruisers. The London *Engineer* in describing these new German boats says: "Save for their greater length they are said to differ but little in appearance from the smaller craft, but the conning tower is somewhat higher and is understood to be well armored, while the two 5.9-inch guns, placed fore and aft of this structure respectively, are fairly conspicuous. These weapons, being on fixed mountings, are, of course, quite exposed to the water when the submarine is below the surface, but it is believed that both guns and mountings are of a special steel which is but little affected by the action of the sea. They must, however, seriously diminish the underwater speed of the vessel. They are apparently of a short, low velocity model, with only a moderate range, but are effective up to the maximum limit of vision possible from the conning tower of a submarine. Germany appears to be quite satisfied with the Diesel engine for the propulsion of her submarine vessels, including the very large types now in commission. Some of the new craft are said to be of about 2800 tons displacement and will have two six-inch guns besides two lighter guns. The estimate that Germany has now 1200 submarines in operation is out of all proportion, even making the most liberal allowance for her shipbuilding resources. If Germany has 200 submarines in commission, in the opinion of experts, she is lucky. She may be now able to turn out ten ubmarines per month and has been making the most xtraordinary efforts to increase the output."

—**Motors**

[The Single Motor for Submarine Navigation. From the Italian. *Memorial de Artilleria*, Nov, '17. 1500 words. **Illustrations.**]

Submarines are provided with two motors, one for surface navigation and the other for submerged navigation. The first is a gas motor, the second is usually an electric motor.

This double motor system is complicated, is very heavy and takes up a great deal of room. A satisfactory single motor system is being sought.

There are six proposed single system groups as follows:

1. The compressed air system in which an air compresser furnishes the power for a compressed air motor; used afloat and submerged.
2. A steam engine system, which may be used both afloat and submerged, the steam being accumulated in a special steam chamber.
3. A second steam system with a modified boiler, which burns liquid fuel in an air-tight firebox by the aid of oxygen injected into the firebox under pressure. The oxygen is derived from certain nitrates.
4. A third steam system in which the heat is produced by the contact of steam with sodium hydrate.
5. A fourth system in which motive power is derived from the explosive mixture of oxygen and hydrogen.
6. A system in which an internal combustion engine is used for both surface and submerged navigation with compressed air tanks to supply the carburetors when traveling submerged.

These systems have been tried out by French, English. American and German inventors ever since 1863.

The net result is that compressed air machines are not powerful enough and limit the radius of activity too much. Steam engines systems heat up the interior of the submarine too much, and the manipulation of a boiler is no easy matter in a small submarine.

An Italian engineer thinks that the solution of sub-

SUPPLY AND TRANSPORT—Continued

marine navigation is the internal combustion motor for both surface and submerged navigation. He believes that fuel for the engine can be derived either by carbureting oxygen with hydrocarbon vapors, as is done in the ordinary gas engine, or by using the exhaust vapors to dilute the oxygen, instead of using atmospheric nitrogen for this purpose; and then to admit this gas mixture at the atmospheric pressure.

Cardile goes into minute computations to prove the possibility of these systems and deduces that a Diesel engine requires 4/5 of the exhaust gases to dilute the oxygen for its carburetor. The remaining 1/5 is forced out into the sea.

In the Cardile system of propulsion the Diesel engines discharge their exhaust vapors into tanks. The required 4/5 is then piped off into a second set of tanks provided with valves. Oxygen at atmospheric pressure is pumped from storage tanks into tubes which carry it to the second set of tanks with valves abovementioned. The gases are carbureted here and are then ready for the cylinders. (The article is not clear as to just how the gases are carbureted.)

As the exhaust gases contain hydrocarbons and carbon oxides, they would produce premature explosions in an explosive engine like the Diesel, so to prevent this the carbon oxide is extracted before the exhaust gases are used.

In order to expel the superfluous one-fifth volume of exhaust gases a special mechanism is necessary. This consists of one pump which forces a constant volume of gas into a condenser and a second pump which forces sea water into the same condenser. By refrigeration the sea water absorbs the oxygen and carbon and hydrate which are then pumped out into the sea near the propeller. This mixes the exhaust solution thoroly with the sea water and prevents these gases from bursting upon reaching the surface and thus giving away the submarine's position.

In the Cardile system the fuel is carried so as to reduce the weight to a minimum. His fuel calculations are as follows: To produce 500 h.p. when submerged requires an hourly consumption of 100 kgs. of liquid combustible and 400 kgs. of oxygen. The oxygen is carried in steel bottles each bottle having a capacity of 21 kgs. of oxygen under a pressure of 120 atmospheres. The weight of each bottle when charged is 196 kgs. Eighteen bottles are consumed every hour. Therefore, the weight for one hour is 3530 kgs., and for 10 hours the weight required is 35 tons. The auxiliary apparatus weights 11 tons. The total weight of the Cardile system is 46 tons for 10 hours' submergence.

With the electric motor and storage battery the weight is 48 tons for 4 hours submergence, and a development of 500 h.p.

The Cardile system does not save much weight but it does increase the radius of the submarine's activity considerably.

The Cardile system has not been thoroly tested as yet.

—Use of in European War

See also

EUROPEAN WAR—GENERAL NOTES—NAVAL OPERATIONS

SUBSISTENCE

—Organization and Administration of

[The French Commissary System. By "F. A." *Memorial de Caballería*, Jan, '18. 5100 words. Diagram.]

In modern warfare it is seldom that an army can live off of the country. In many cases, as in Europe in the present war, the armies must themselves feed the inhabitants, and may depend upon the local resources only at the very outset of the campaign, while the regular system of supply is orienting itself.

In France, the following system, planned before the outbreak of hostilities, is in use. In each department, under the prefect as president, there is a departmental committee on commissaries, composed of the local representative of the intendance and several civilians. Having been assigned a quota, this Committee assigns quotas to each of the outlying collecting depots, which in turn collect from each municipality. Prices are as prescribed by the Ministry. As the merchants offer much higher prices than does the Government, considerable difficulty is at times experienced in the purchase of foodstuffs. At times the farmers are prone to plant crops that will find a market with the merchants and not with the government. Recently there has been an agent from headquarters with each committee, whose duty it is to maintain connection and to further co-operation with the Intendence.

After being passed upon and accepted by a board, supplies are now forwarded to the commissary depots in the zone of the interior. Here we have slaughter houses, bakeries, etc.

Trench warfare, having temporarily rendered the army immobile, has caused the disappeareance of all trains above the divisional. It has also brought about the temporary disappearance of the field bakery.

From the commissary depots, provisions are forwarded to regulating stations, situated at railroad centers, thence by rail to the distributing points at the railheads, and are there turned over to the divisional or regimental trains, or, at times, to narrow gauge railroads. These distributing points are as far advanced as practicable, and of necessity are of very temporary nature.

SUPPLY AND TRANSPORT

See also

AUTOMOBILES
DOGS
MOBILIZATION
MOTOR TRANSPORT
PRISONS, MILITARY—TRANSPORTATION OF PRISONERS
RAILROADS
SANITARY SERVICE—TRANSPORTATION OF SICK AND WOUNDED

[Mud Toboggan to Carry One Stretcher or 200

Pounds. By Maj. A. C. Finnimore, R.E. *Royal Engineers Jour.*, Nov, '17. 300 words. 1 plate.]

Many experiments have been carried out in an attempt to discover the easiest method of carrying weights over mud, into which ordinary wheels sink deeply. Sledges of many varieties were tried and the following main principles were established:

Resistance to traction increases nearly proportionally to the area in contact with the ground except when this area is very small. Runners or ribs under the sledge largely increase the resistance to traction.

Sharp edges gather an accumulation of mud and increase the resistance. The smallest resistance was obtained with a spoon-shaped sledge with curves of large radius. This necessitates a very low center of gravity to prevent capsizing on uneven ground or when turning sharply. The design adopted is a modification of the last. It is flat enough to be stable, but leaves the ground in easy curves everywhere.

A pair of 4" by 1" inner gunwales is used, which fit in between the legs of a stretcher (1' 6" inside to inside). They are cut to a slight curve which becomes more abrupt towards the ends. The canvas of the stretcher, sagging between the inner gunwales, lowers the weight of the man without actually bringing him in contact with the frame of the vehicle. To the inner gunwales are attached a series of 2" by 1" bottom cleats, which support a sheet iron outer skin. The sheet iron is curved up at the edges to meet the 8" by 1" outer gunwales spaced two feet inside. The outer gunwales take little weight normally and are chiefly intended to keep out the mud. Each end sweeps up to the top of the gunwale in a full center curve of about one foot radius. The forward curve is continued some six inches above the gunwale.

The toboggan is nine feet long overall. It will carry one stretcher or 200 pounds.

[A Comparison Between the Logistics of Armies and Fleets. By Maj. Robert E. Wyllie, C.A.C. *Jour. U. S. Artill.*, Sept-Dec, '17. 4000 words. 3 tables.]

Fleets and armies require supplies for their maintenance and operation, and a strategic plan is valueless unless based upon sound logistics. Due to the fact that we (United States) are separated by sea from our more formidable possible military adversaries, the logistics of combined naval and military movements are of especial interest to us.

Naval and military logistics present certain important differences. Food, clothing, ammunition, and personal equipment, the transportation of which constitute a large part of the entire logistic problem of an army, can be carried in quantity sufficient for several months by a fleet. With mule-drawn transport, a division can only get about 30 miles from rail-head. Motor transportation serves practically to advance the rail-head within reasonable limits. But there are other supplies, in the aggregate of enormous volume, required by an army, such as wire, tools, lumber, light railway material, reinforcements, recruits, remounts, etc.

Altho the fleet itself solves the problem of the transportation of supplies for personnel and armament, it is entirely dependent upon fuel and docking and repair facilities. Fuel is a question of steaming radius of the units of the fleet and of colliers. Docking and repair facilities must in the major sense be arranged in time of peace in proper relation to prospective theaters. Repair vessels can take care only of minor repairs.

A fundamental difference between the military and naval lines of communications lies in the fact that the naval lines are not fixed, and raids on naval lines of communication are consequently more difficult than similar operations against military lines. The problem of the fleet is principally one of bases. If these have not been provided in time of peace, the fleet is helpless. The security of these bases must be provided for, otherwise the fleet will be tied to them and lack freedom of movement. (The requirements of a joint overseas expedition to eastern waters involving the fleet and an army of 100,000 men are then considered. The requirements of the fleet are estimated at approximately 1,085,000 gross tons of shipping, and of the army at 860,000 gross tons, including supply after landing. The entire merchant marine of the United States (December, 1916) is 2,169,819 gross tons, but little more than the requirements of the fleet and army as given.)

The lesson to be derived from this study is the necessity for improving and fortifying bases in all probable theaters of operations, and the great importance of developing our merchant marine. These two factors have made possible the naval success of Great Britain.

[Rail and Motor Transport as Applied to Military Operations. By Col. P. S. Bond, C. of E. *Professional Memoirs*, Jan-Feb, '18. 6000 words.]

(An interesting article showing the great importance of mechanical transport in the conduct of modern military operations, both for the movement of troops and of supplies and ammunition. The general scheme for the supply of a modern army is outlined, and the parts played by the standard gauge railroad, the narrow gauge railroad and the motor truck are shown. The necessity for a comprehensive system of good roads to permit of the advantageous employment of motor transportation is dwelt upon. The author clearly shows the great responsibility which rests upon the supply service of a modern army in the field.)

[Battle Front Transportation. By Lieut. Roger Haydock, Eng. R. C. *Professional Memoirs*, May-June, '18. 8000 words. Illustrations. Diagrams.]

In order to get the requisite immense quantities of stores up to the firing line an elaborate system of railroads, roads and cableways has been placed in operation in the war zone. The standard gauge railroad track runs as close to the line as safety permits. The contents of the trains are there removed and stored temporarily. At that point the narrow gauge railway and the motor truck take up the work of transportation to the front line supply stations.

SUPPLY AND TRANSPORT—Continued

The chief cause of freight congestion is delay in handling at the terminals. Every effort is made to remove everything from railhead as rapidly as it arrives. Car shortage has also played havoc with the efficient delivery of freight, but a great deal of this can be and has been obviated by loading every car to the maximum and increasing the speed of freight trains.

The design, layout, and operation of the standard gauge railroads are carried out as in ordinary practice, but with the light railways much depends upon local conditions. The system is very complex as a rule, radiating in many directions from centers or terminals. The tracks are interlaced in order to give great flexibility; all important points are hooked up with the system, and usually there is a line paralleling the front line trenches. The rails of the narrow gauge weigh from 20 to 25 pounds per yard. Small steam locomotives of the 2-6-2 type, weighing about 17 tons, are used up to the point where the smoke and steam would betray their presence to the enemy. From there the trains are hauled farther forward by gasoline or electric locomotives, or by animal power, and then the material is transported to the front line supply depots by trucks or teams.

The light railways were developed to relieve the highways of the brunt of the heavy traffic. Experience has shown that the heavy trucking is responsible for the excessive wear and tear on the roads. The removal of the bulk of this traffic to the light railways does much toward the solution of the problem of maintaining the highways. The light train of six cars carries about 60 tons. It is thus the equivalent of 20 trucks.

Important as the railroad system is, it is of little use without a highly developed system of good highways. The absolute necessity of good roads, kept in the best possible condition, is constantly increasing. The modern military road, in order to fulfil its mission for any length of time must be built with all the care of a modern civil highway. Of course, we still have the temporary road built of dirt, cinders or corduroy, but these are used only in cases of emergency, and must be quickly replaced by some form of good surfacing. Modern military requirements upon roads are very severe, and only those of the highest type can stand up under the heavy strain imposed upon them.

(The writer here discusses in considerable detail the various elements entering into the design and construction of modern military roads. Summed up, the requirements are for as high a type of road as is practicable, subject to the fundamental necessity for speed in location and construction.)

Realizing the great importance of being able to cross streams, all modern armies are supplied with pontoon and portable military bridge trains so that they are not dependent upon the improvised makeshifts hastily constructed on the site. The present war has brought about no important changes in the pontoon equipment of armies. The portable military bridge trains are provided with the necessary cut timber, trussed wood stringers, I-beams, plate girders, latticed steel trusses and accessories which permit the building of a bridge more permanent than the hasty structure which must be improvised in the absence of such material. These portable bridges are standardized, and many of their parts are built up in the depots and shops in rear. The framing and joining of the timbers is as simple as possible. Metal trusses are already built up as far as possible so that the structure can be erected with little more than the addition of a few bolts, which can later be replaced with standard rivets for permanency. The extremely heavy loads of the present war have necessitated important changes in the design of military bridges. The heaviest field piece found in our (U. S.) army is the 12-inch howitzer, which weighs approximately 27,000 pounds, the front wheels taking about two-thirds of this, or 18,600 pounds. It has been specified for our bridges, however, that they shall be designed for a live load of 38,000 pounds on one axle with a wheel gauge of 6 feet, or a live load of 100 pounds per square foot over a 12-foot roadway.

In an advance, time is a paramount factor in the crossing of streams, so we will still see the improvised bridge used in some cases. They will always be quickly replaced, however, by a more permanent construction at the earliest opportunity.

Boardwalks play an important part in the system of battle front transportation in the present war. Starting well back of the front line trenches, at a point where vehicular transport can no longer be continued with safety, they are the means by which most of the supplies are brought up to the fighting line. By their use, trenches which would otherwise be impassable quagmires are converted into arteries of communication. The walks are made up in standard sections behind the lines.

Another interesting and important means of transporting supplies is the cableway and aerial tramway. The cableway has been used with marked success in the mountainous districts, especially in Italy and in the Vosges Mountains. Various modifications of the tramways are used in the trenches.

France

[Supply of the French Army. By Gen. Thevenet. *Infantry Jour.*, Nov, '17. 4500 words.]

Troops have to be supplied with everything required for existence and for fighting. Supplies must be regular and constant for rations and variable for ammunition, clothing and equipment, depending on the needs of changing situations. The duty of supplying the needs of an army is entrusted to the commanding general, who is aided in this by his general staff, and the supply services and various corps of the army.

In the immediate neighborhood of the front the local resources have long since been exhausted. In the zone immediately in rear there are to be found cattle, straw and forage, but their use is hampered by the necessities of the civilian population living there. Wood is the only appreciable resource obtainable from the zone occupied by the armies.

The whole system is based upon the organization of a constant flow of what is needed from the rear. Armies must receive a steady stream of men, horses,

food and ammunition.

Men are replaced by detachments from the depots in the corps mobilization districts from which the units come. Reinforcements from the depots of the interior are made upon request from the corps which they supply. The detachments formed in the depots are sent to the assembly station of the district, and from there to the supply station of the army.

The supply of rations is directed by supply officers, who also supply clothing and equipage. Each army corps receives daily its ration train from the supply depots, ports or bases in rear. Thirty cars are necessary if the corps is composed of two divisions. Other cars, to complete the train, carry mail, packages, men and supplies which are not sufficient to require a special train. These ration trains leave the central supply station in the evening or night in time to leave the cars at the various unloading points in the early morning, and under favorable transportation conditions the smaller units have received their rations by noon.

The daily ration train brings a complete ration of bread, wine, dry vegetables, oats, salt, sugar and coffee; it also takes as frozen meat a portion of the meat ration. At the beginning of the war all the meat for the troops was supplied on the hoof, but now frozen meat from America has largely supplanted this supply. The rationing of the troops, in the event of the non-arrival of the daily train, is provided for by stores of reserve rations.

A small part of the supplies of clothing, shoes, underclothes and camp equipment is sent direct from the depots to the mobilized units. The greater part is supplied on requisition from each army on the supply depots assigned to them. These depots are on a railroad which forms the line of communications of the army, and are kept filled by the central administration. Repaired articles are sent to organizations in the interior, those at the front are kept supplied with the new.

The consumption of ammunition during this war overwhelmingly surpasses all expectations. The artillery of the army which is charged with the replacement and filling up the trains of the army corps has mobile reserves and also stores of ammunition which, on its order, the regulating railroad station sends forward. All ammunition depots on the front and at the railroad stations are carefully guarded. The depots are so arranged that ammunition can be shipped by the 60 cm. railway or by motor trucks.

Provision is made for speedy repairs to both the guns and wheeled vehicles. Some establishments, especially those devoted to the repair of heavy guns are really factories where guns are made over and then returned to the front.

The expenditure of engineer matériel has risen to unheard of proportions in this war. Behind the front the engineer transport train of the armv has remained as a reserve. The army engineer depots are arranged to permit easy loading and unloading of trains from the rear. The engineers must provide large quantities of stone for the roads as well as matériel for trenches, mines and shelters. The construction of camps and hospitals falls on the engineers. The Adrian type of knock-down barracks is now widely used. The engineers are also charged with establishing and maintaining the water supplies.

Germany

[Rationing of the German East Front. By Marquis de Zayas. *La Guerra y su Preparación,* Aug, '17. 3000 words.]

Hindenburg's strategic maneuver, which was started by Mackensen's breaking the Dunajec line added 112,000 square kilometers to the German productive territory.

The Russians, in their retreat, had thoroly devastated the country and the German General Staff of the army of occupation faced a tremendous task of reconstruction and administration. Lines of communication had to be entirely rebuilt, cities and towns made habitable, and the production of the country started anew in order to assure the food supply of troops on the eastern front.

The German military authorities took over all civil powers and reduced the civil government to impotence. The country was then divided into 4 rationing districts as follows:

1. Curlandia, 20,500 square kilometers, 210,000 inhabitants.
2. Lithuania, 31,100 square kilometers, 1,126,000 inhabitants.
3. Wilna-Suwalki, 26,500 square kilometers, 1,000,000 inhabitants.
4. Bailystok-Grodno, 25,800 square kilometers, 712,000 inhabitants.

The inhabitants of all these districts were mostly Poles, Germans and Russians, the latter being in majority.

An inspector of rations was appointed for each district who was also administrative chief for his territory. Each inspector was chosen from the officers of the army and was assigned assistants to help him carry on all forms of civil government.

In a short time the entire aspect of the country changed. From a barren desert it became a very well ordered and productive country, and a great help to the German imperial forces. The greatest difficulty that the Germans faced was the lack of communications. There were very few railroads, and these of a very inferior construction, and in some districts there were not any wagon roads, communication being maintained over undeveloped trails and country roads which became impassable when it rained. The construction of wagon roads and railroads was started immediately and the lines of communication were soon finished.

To re-establish the stock, cows, horses, sheep and pigs were brought from Germany, and these were followed by seeds and farm machinery. Supply depots were established where seeds and farm implements could be secured. Compulsory agriculture was put into effect for all inhabitants; prisoners were divided into labor brigades and set to work. Cavalry horses were used to till the soil when not needed at the front; and every means taken to plant a crop and see that it was harvested.

SUPPLY AND TRANSPORT—Continued

Lumber is one of the greatest natural resources of this occupied territory, the forest of Bialowies, which is the largest numbering 128,000 hectares of surface. This forest, like all others, is being thoroly exploited by the Germans. Some extent of the work carried on there may be judged from the fact that 5000 soldiers are required to act as military police of the district. The men, women and children of the occupied territory are forced to work in this forest. A reserve lieutenant-colonel, formerly a large land owner of Saxony, is in charge of the Bialowies forest project.

Education has been given a great impetus by the Germans. In most cases the schools are under native teachers with a German soldier as superintendent.

Finally, in 1916, the German General Staff organized a banking system by which the inhabitants could borrow money, as the lack of currency had become a very serious menace.

SURGERY, Military

See also

AMPUTATIONS

[The Place of Orthopedic Surgery in the Treatment of the War Casualties. By Major J. E. Goldthwait, M.O.R.C., U.S.A. *Military Surgeon*, Oct, '17. 2600 words.]

(A discussion of the importance which orthopedic surgery has assumed in the present war. The author describes the organization and some of the results in England, where the work has been broadly developed with most striking results. Orthopedic surgery has been forced to occupy such a conspicuous position in this war that much of the work which is now being developed is bound to be preserved to meet the civil needs when the war is over.)

[Some Observations on Injuries of the Head. By Maj. Homer Gage, M.R.C. *Military Surgeon*, Mar, '18. 3500 words.]

A fundamentally important thing to remember in considering injuries involving the cranium and the brain is that injuries to the cranium are of importance only as they expose or injure the brain and its membranes. In the second place, it must be remembered that anatomically the cranium is a hollow shell with sufficient elasticity to bend and rebound. Thus injury may result in local bending with lesion at or under the point of contact; or it may result in a bursting of the wall opposite the point of contact with a consequent distant lesion; or, lastly, the injury may result from the expansive force of a missile passing thru the skull at a high velocity. The smaller the point of contact between the force and the bone the more likely is the lesion to be the result of the bending of the skull and to be localized at the seat of injury. The broader the point of contact the more likely is the injury to be a bursting one on the opposite pole of the hollow skull.

(The writer proceeds to a discussion of the various kinds of injury to the skull and the different parts affected. He then takes up the subject of operations, when it is desirable to operate and when not. The following rules are enunciated, based upon the author's experience:

1. In all cases of localized pressure, as determined by localized symptoms of paralysis or cortical irritation, operate.
2. In every suspicious borderline case, determine condition of bone over suspected area by exploratory incision of scalp.
3. In every depressed fracture, simple or compound, with or without symptoms, elevate.
4. In all depressed or perforating wounds remove all loose spicules of bone; leave the edges of the bony opening clean and smooth.
5. Remove foreign bodies always if they are likely to cause infection or if they are giving rise to symptoms. In other cases remove when possible without too much traumatism, remembering that a possible harmless encystation is better than the certainty of destroying important cerebral centers.

An important question is: Where shall the operation be made—how near the front? The French, British and German practices in this regard are discussed.)

[The Services of Modern War-Surgery. By Prof. Dr. Kirschner. *Schweiz. Monatschrift aller Waffen*, Nov, '17. 2700 words.]

At the outbreak of the present war the majority of physicians had little practical experience of war conditions, and those who had were mostly neutrals who had in previous wars been permitted to serve only at a distance from the front, at hospitals to which the severest cases were not brought. Also, in former wars the use of grenades and mines, which produce the severest wounds, had not developed. Consequently at the outbreak of the war the most excellent surgeons found themselves faced with problems theretofore only partially solved. But they attacked the problems with iron energy, and have brought the science of war surgery to a condition of remarkable development.

The progress of modern surgery rests on two bases: anesthesia and asepsis. The former principle was already well known during the war of 1870-71, but has been since greatly developed. "Rausch" narcosis is now used with success for operations of short duration. Local anesthesia by injection of solutions which affect the nerves is new. Even serious operations can be undertaken by this method: for example opening of the skull and operations on the brain.

Surgery and bacteriology have demonstrated that wound infection is due to the presence of pyogenic bacteria. Consequently if all such bacteria are kept from the wound, infection cannot result. This requires careful sterilization: metal instruments by boiling, fabrics by steaming, the hands of the surgeon by soap, water, and disinfectants, and by the use of rubber gloves, and the skin of the patient by application of tincture of iodine. All this requires extensive apparatus, which it is difficult to provide in the vicinty of the battlefield. Consequently it is the task of war surgery to bring the patient as quickly as possible to a place where these things are assembled. The most advanced sanitary formation where serious operations can be undertaken is the field hospital. Further treatment is

given in the base and other hospitals at home. In more advanced formations only the most urgent operations, such as the stopping of hemorrhages and the opening of the windpipe in case of suffocation, can be undertaken.

Often the victim, as a result of nerve-shock accompanying the wound, followed by severe blood loss, long exposure, and uncomfortable transportation, arrives at the hospital in a condition which renders even necessary operations impossible. Modern surgery attacks these conditions by saline injections, heart stimulants, and blood transfusion. The latter is particularly valuable, but depends on the availability of someone willing to furnish the blood.

Altho the sole cause of wound infection is the presence of bacteria, the latter does not always cause infection, if the body is strong and if the number of bacteria does not exceed a certain maximum of numbers or virulence. War surgery has taken advantage of this fact. Rifle and shrapnel bullets which strike the victim directly do not carry many bacteria, and unless a bone is struck the healing of the wound is not difficult. The only care of the surgeon is to prevent secondary infection. For this purpose tincture of iodine is applied to the vicinity of the wound, and the latter is bound with sterile material such as the bandage carried on the person by the soldier. Splints or plaster of Paris are also applied to insure rest. Recovery generally follows in one or two weeks. In the case of wounds produced by grenade or mine fragments or by bullets which ricochet, circumstances are different. The wounds are larger and more irregular, the tissues are macerated, generally bones are splintered, and, since the missiles have usually thrown up earth or come in contact with it, and much clothing has been driven into the wound, there are many bacteria introduced. If such wounds are bound up at once, inflammation results which may result in necessity of amputation of a member or even death. This fact was not realized at the beginning of the war, but was demonstrated in the first few months. Now the patient is anesthetized as soon as possible, the wound is opened up, rinsed, irrigated, dressed with disinfecting gauze, for example, iodoform gauze; drainage tubes are inserted to accommodate the flow of the wound secretions; bandages are changed daily. By this method "gas infection" is combatted. This infection, which is characterized by small gas blisters in the vicinity of the wound, and which is caused by anerobic bacteria, resulted in many fatalities at the beginning of the war, but now is under control.

Joint wounds require special treatment, both because such localities favor the multiplication of bacteria and because of the danger of stiffening. The former condition is combatted by incisions and drainage, and if necessary by removal of the joint. The latter requires the closing of the wound, the practice of movements, and sometimes operative mobilizing of the joint.

[The Services of Modern War Surgery. By Prof. Dr. Kirschner. *Schweiz. Monatschrift aller Waffen,* Dec, '17. 3050 words.]

If a wound infection cannot be conquered, amputation of the member must follow. This is relatively seldom undertaken, and then as a last resort. After the amputation, steps are taken to prepare the stump to carry an artificial limb. The latter have been so well constructed that in many cases the patient is enabled to take up his calling unimpeded. Wooden legs have been so developed as to enable even the patient who has lost his thigh to proceed without difficulty over plowed land. Artificial hands are now provided which can be manipulated voluntarily by the muscles in the stump.

A much feared wound infection of earlier wars was tetanus. This infection may occur in small wounds, which show no inflammation, and which heal over before symptoms of tetanus appear. The disease manifests itself in muscular paralysis which ends in painful death. The infection has almost disappeared in the case of battle casualties, because the injection of anti-tetanus serums is now required in the case of every wounded patient. In the few cases in which tetanus appears, it can generally be cured.

Bone fractures are common results of wounds. The surgeon has two tasks: to restore function and to restore anatomical form. There are two general methods: one by the use of splints and plaster of Paris, and the other by means of weights attached to the injured member. In the case of large wounds the former method is used, commencing with the setting of the bone under anesthesia. Unless infection is present, bandages are changed frequently to permit movement and massage to restore mobility. The second method is used where applicable, especially in case of a broken leg. The best success is obtained by attaching the weights by means of nails to the bone. In any case, orthopedic methods are employed after the bone has knit until the use of the injured member has been as fully as possible restored. If the bone has knit in a bad position, the defect can be later remedied by resetting, or by cutting into the bone in its sound part and applying the nail extension method.

A result of the position war has been an increase in the number of skull wounds. The greater number of these is instantly fatal. Nevertheless a number of cases, even where the brain has been pierced, reach the surgeon. The first danger is infection. Prompt operation to remove foreign bodies is therefore necessary. The operation also prevents protrusion of the brain. Even after healing there is danger of brain abscess, which requires a new operation. If the wound is in the vicinity of the brain centers which control the voluntary muscles, convulsions with loss of consciousness, like epilepsy, may later result. This is relieved by removal of the body which produces the pressure, and sometimes by transplanting tissues from other parts of the body. Holes in the skull are now covered with living bone.

The great danger of breast wounds is excessive loss of blood; if the wound is large there is danger of suffocation. Prompt closing of the wound is necessary. If the bleeding of the lung does not stop automatically, the surgeon uses the pressure difference method, bares the lung surface, and sews up the wound. The next danger is an inflammation of the pleura, necessitating removal of part or all of a rib to permit the matter to drain off.

SURGERY—Continued

Abdominal wounds generally result in death unless treated within a few hours. The first danger is excessive loss of blood; the second is peritonitis due to the escape into the abdominal cavity of the contents of the intestines. Rapid and comfortable transportation, well provided hospitals near the front, and skillful surgeons are necessary. The intestines must be sewed up, or removed in part. In case of a bladder wound the bladder must be sewed up; in case of a kidney wound it may be necessary to remove a kidney.

The damage caused by the cutting of the spinal cord cannot be remedied; if, however, a wound produces pressure on the cord, function can be restored by removal of the pressure.

If an artery is cut, death from loss of blood often results. Sometimes, however, the blood clots. To prevent renewal of the bleeding, the artery must be sewed up. There is also danger of aneurism thru swelling of the arterial wall or infiltration of blood in the surrounding tissue. An aneurism may cause pressure on the nerves, and may burst. It must therefore be removed. This operation is a very delicate one, as it may result in bleeding to death. If possible the artery is sewed up; if the gap is large, pieces of blood vessel are transplanted.

In case of cutting of a nerve, function in the muscle affected is seldom automatically restored. The nerve must generally be sewed, and this does not always result in restoration of function, and then only after a long time. In some cases it is necessary to graft the separated ends onto a sound nerve. In some cases function is disturbed because a scar causes pressure on a nerve. The pressure is generally easily removed.

If a bullet is imbedded in the body, it need be removed only if it presses on a nerve, lies against the wall of a large blood vessel, is imbedded in a joint, produces inflammation, or causes pain. Removal is aided by the Roentgen process, which may be applied thruout the operation. Magnetic substances may be extracted by strong electromagnets.

The majority of wounded persons can, by surgery, be restored to military service, of those not so restored, the majority can be so healed as to become useful members of society.

SWEDEN

—Naval Policy of

[The Naval Defense of Sweden. *Kungl. Krigsvetenskaps-Akademiens Tidskrift,* June, '18. 2300 words.]

A complete plan for the development of our naval defense was proposed in the session of the Riksdag (1914) for a period of 20 years. This navy plan was, however, not accepted in its entirety, only five years were adopted, *i.e.,* up to and including 1919. It was lucky that it so happened, because we will now be able to develop our naval defense according to the experiences of the world war in the manner most adequate for our circumstances.

According to the bill of 1914 the navy shall consist of a coast navy and local navy (local forces).

The coast navy.—This navy, the main part of the naval defense. shall be able to operate without and within the "Skargard" (Swedish for a belt, sometimes up to 20 miles broad, of small islands outside of the mainland) and ought to be so strong that it could successfully defend the country.

According to the plan of 1914, the coast navy will consist of eight armored warships, sixteen destroyers, two divisions of larger U-boats, and two mine ships.

The types most advantageous to us are destroyers, U-boats, and mine ships. The number of destroyers corresponds to only two thirds of our needs. The German active navy at the beginning of the war had among others 24 battleships and 69 destroyers, which makes the ratio between battleships and destroyers 1:3. The same ratio is found in the Russian program for the Baltic fleet of 1912.

We have no cruisers except the *Fylgia,* which will soon be out of service and will not be replaced. Our four torpedo cruisers are no longer adequate for scout service, hence our destroyers will have to render service also as scout vessels. The U-boat most adequate for our defense ought to have 1200 tons' displacement, four 75 mm. guns and three double torpedo tubes, a speed of 20 knots on and 12 knots below the surface (so-called U-boat cruisers).

In 1914 two divisions of large U-boats were considered sufficient; however, experiences of the war teaches us that it is necessary to equalize our naval inferiority thru the strongest development of submarines and mines. Thus the number of large U-boats (U-boat cruisers) ought to be at least six divisions for the coast navy and some of the larger type also for the local navy according to need.

The mine ships ought to be of about 2000 tons' displacement, armed with four 12 cm. guns, four 57 mm. guns, and two machine guns, speed 24 knots. These ships might be called mine cruisers. The coast navy ought to have at least six. Besides there ought to be at least two divisions of mine sweepers.

The air service ought to consist of four divisions of five machines each (two in reserve).

At the end of the next period of five years, *i.e.*, 1924, our coast navy should, according to this plan, consist of two squadrons each comprising one division of first class armored warships, three divisions of destroyers, three divisions of U-boat cruisers, three mine cruisers, one division of mine sweepers, two air squadrons with one supply ship, and in addition one torpedo cruiser (tender), one repair ship and one hospital ship.

Such a coast navy is composed according to the objectives to be attained at the breaking out of a war and according to circumstances.

The local navy.—This part of our navy comprises the local squadrons, the service of which is confined to certain parts of the coast. These coastal territories would mainly be: the Skargard of Stockholm, the coastal territory of Blekinge, of the country of Vasternorrland, of Norrbotten and the Skargard of Bohuslan. These five coastal territories, very important from a military as well as a commercial view, ought to have each a local squadron besides coast fortifications. The

local navy thus ought to comprise five local squadrons, *i.e.*, the squadrons of Stockholm, Karlskrona, Harnosand, Lulea and Gothenburg.

The local navies ought to be furnished with ship material mainly thru transfer from the coast navy of obsolete material, which in the coast navy would be replaced by new construction.

New constructions for the local navies seem to require three mine ships, four supply ships, and nineteen hydroplanes.

A local squadron would, as a rule, consist of one first class armored warship (this type is as a rule not big enough to be called a battleship nor fast enough to be called a cruiser, hence the expression armored warship), one torpedo boat flotilla with two divisions of torpedo boats including the torpedo cruisers or a destroyer, one division of U-boats with supply ship, one mine layer, a division of mine sweepers, and an air squadron with supply ship.

This development of the local naval defense will be an important branch of the defense of our country, allowing our coast navy liberty of operation within its own objective.

Bases of operations.—The waters which surround the coasts of Sweden may be divided into five maritime territories, namely, the Bothnic Bay, the Bothnic Sea, the North Baltic, the South Baltic and Cattegat. The bases of operations of these territories would be Lulea, Harnosand, Stockholm, Karlskrona, and Gothenburg. Of these only Stockholm and Karlskrona are naval ports at present; Gothenburg and Harnosand will, according to the plan of 1914, become such, whereas Lulea has not yet come into consideration for a naval base. However, fortification of the latter is necessary for the security of the coast of Norrbotten and to prevent hostile landing operations, which in combination with hostile operations on the northern frontier may be directed against the fort of Boden and the lines of communication of the north army, further for operations against the communications of the adversary along the coast, which is here especially exposed to attacks from the sea, and further for tactical cooperation during important operations in the coastal territory.

The Swedish coasts are especially well suited for defense thru the existence of the Skargards. The issue is to utilize, as rationally as may be, these possibilities.

—Navy

[Activity of the Swedish Navy in the Year 1917. *Kungl. Krigsvetenskaps-Akadamiens Handlingar,* Jan, '18. 250 words.]

As during the past year (1916), our navy has been mobilized also during the course of this year (this lecture was given at the assembly of the academy on the 20th of November, 1917) and has been in uninterrupted activity to prevent violation of our neutrality within Swedish territorial waters. Only once such violation has taken place. In several cases such violation has been prevented thru the timely arrival of a Swedish man of war. On account of the insufficient number of ships in our navy, the patrol service has been arranged in such a way that our men of war have sailed on certain publicly given dates from different places, moving along the coast. Our own as well as foreign vessels have used this opportunity of convoy to a great extent.

Besides patrol service, the activity has embraced looking for and putting out of commission mines in our territorial waters. Since the beginning of the world war not less than 1500 mines have thus been destroyed.

[New Constructions Within the Swedish Navy. *Kungl. Krigsvetenskaps-Akademiens Handlingar,* Jan, '18. 1 plate and 1 table. 2600 words.]

On the 10th of May, the armored warship *Sverige* was delivered to the Swedish navy, just ten years after the delivery of the previous one, *Oscar II.*

After the rupture between Norway and Sweden, the advisability of a stronger defense as well as a stronger navy was emphasized. After five years the so-called F-type was chosen from twelve different types, and means for building were granted in the session of the Riksdag of 1911. The construction was, however, postponed until some patriotic men appealed to the Swedish people for means to start the building. This appeal was published on the 27th of January, 1912, and by the middle of April the necessary money was subscribed. The 7th of May the money was handed over to the Swedish king, who decided to ask the opinion of both chambers regarding its acceptance. Both chambers endorsed the acceptance of this gift on the 21st of May.

The ship was built at Götaverken of Gothenburg with the assistance of some othe ship yards, and was launched on the 3d of May, 1915. Two years later it was finished, considerably delayed by the world war.

The ship has the following main dimensions: Length 120 m.; breadth 18.6 m.; depth (with normal bunkers of 340 tons) 6.28 m.; corresponding displacement 7100 tons; speed 22.5 knots; water line armor, greatest thickness 200 mm., diminishing fore and aft; citadel armor, 100 mm., above the water line armor, and covering the middle of the ship; gun turret armor, greatest thickness 200 mm.; battle turret 175 mm.; armored deck 40-30 mm. Some of the vertical armor and the whole armor deck has been delivered in the country (from Bofors), but all vertical armor above 100 mm. has been obtained from the United States.

Machinery.—Steam turbines (A. E. G. Curtis) for propellers; 12 Yarrow boilers of modern type, for coal fuel and for mixed fuel (coal and heavy oil). The speed, 22.5 knots, has been considerably exceeded in the trials.

Armament.—Four 28 cm. guns; eight 15 cm. guns; six 75 mm. guns. (Here follow particulars regarding caliber, ammunition, placing, etc., of all the guns).

For the direction of fire the latest arrangements have been made. In the back part of the commander's turret a special fire directing station is provided, where the artillery officer is meant to be during battle. In case of interruption of telephone and speaking tube communications with the centrals below deck, the division commanders and lastly the turret commanders will take command, for which case every turret has

SWEDEN—Continued

an armored top from which the respective turret commanders may observe and direct the fire.

Torpedoes.—Two 45 cm. under water side tubes. Torpedoes of newest type, made at Karlskrona, range 6000 m., speed 30 knots; at 3000 m. range the speed is 40 knots. Charge 110 kg. trotol.

Arrangements for navigation.—The ship is navigated from the battle turret. A novelty is the gyro compass (instead of the magnetic needle, the gyroscope is used). By electricity the gyroscope is made to rotate with an enormous speed: it has several sister compasses to which the direction is given by electricity. Hospital arrangements and arrangements for the well-being of the crew are excellent.

Supplies.—The ship can take 700 tons of coal and 100 tons of oil for fuel: the coal will last for ten days' uninterrupted going (9 knots); provisions for 90 days; water may be distilled on board, besides there is space for water for four days. This ship may be considered the strongest of any navy in comparison of displacement, armor and speed. The explanation lies in the small space for supplies, which do not need to be very large in a ship operating only on its own coast.

Sverige is, however, not an increase of the strength of the Swedish navy, but is only replacing a ship which has become obsolete on account of age. (Here follows a table of the fighting value of the Swedish war ships based on their age.)

Of the destroyers which are included in the plans for new construction during 1915-19, two (called *Wrangel* and *Wachtmeister*) are under construction at the ship yards of Lindholmen of Gothenburg. The first was launched in September, 1917. These destroyers are somewhat different from the previous ones. They are higher forward and thus are more sea-worthy. The speed will be greater.

The armament is the same as on previous destroyers, but torpedoes are increased from two single tubes to two double tubes and two single tubes, making possible the firing of six torpedoes simultaneously. In this connection it may be mentioned that similar arrangements have been made on the destroyers already in commission.

Submarines have been built and are under construction. The number as well as their construction is secret.

Construction and reconstruction within the coast artillery and the flying corps of the navy is not of such a nature that it may be published.

SWITZERLAND

—Army

See also

MORALE (Article: "Comparison and Conclusion")

—Army—Artillery

See also

MACHINE GUNS—SWITZERLAND

MACHINE GUN—TROOPS—ORGANIZATION

—Army—Cavalry

See

CAVALRY—ORGANIZATION—SWITZERLAND

—Army—Supply and Transport

See also

MOTOR TRANSPORT—SWITZERLAND

—Military Policy of

[Preparation for Trench Warfare in Our (Swiss) Army. By Maj. de Diesbach. *Revue Militaire Suisse*, Oct, '17. 1500 words.]

There is one kind of combat of whose methods and details we (the Swiss) are still ignorant, and that is the war of the trenches. One thing is certain, trench warfare presupposes a gigantic artillery, ceaselessly renewed and added to, and a practically unlimited supply of projectiles. It is impossible to attack without a prelude of destruction and a complete isolation of the sector attacked by a barrage lasting until the consolidation is complete.

If we were attacked, it would probably be from two sides at once, in which case our permanently fortified sectors would permit us to operate more freely with our mobile army. Notwithstanding this there is opposition to the maintenance of these permanent fortifications on the grounds that they do not cover the entire periphery of our country, or that they are superfluous and uselessly expensive. It is doubted that trench warfare would result from the first contact with the enemy in our fortified sectors. Our positions should be so concealed that it would be a long time before we could be deadlocked in trench warfare, such warfare being impossible until the enemy positions are fully known. But in this type of combat any enemy whom we might meet would be past masters. We must train in defense for that event and do so before training storming battalions.

[The Origin of the Swiss Military Exemption Tax. By. Lt. W. A. Immer. *Schweiz. Monatschrift aller Waffen*, Oct, '17. 1750 words.]

The military exemption tax is an old Swiss institution. At times it has served as a model for other states. To-day increase of the tax is advocated to restore the financial equilibrium disturbed by the war. At first the tax was a cantonal affair. In 1632 Freiburg levied a general military tax, which bore more heavily on those exempt from service than on those not exempt. Geneva had an exemption tax in 1540, and again in 1670, but in 1697 abolished this system in favor of a paid standing army. Under the latter system a general military tax was levied for support of the troops. Similar systems existed in other cantons. They are not to be confused with the exemption tax. The exemption purchase is also a different system. The latter applies to persons not otherwise exempt, and exists in Spain. The exemption tax applies to persons of military age who are exempt because of physical or mental disability or because in government service.

The exemption tax is defended on two grounds: first, on the political ground that every citizen should contribute to the defense of the state, and second, on the economic ground that the exempted persons should be put on an even basis with those forced to serve. Opponents of the tax characterize it as an example of fanaticism for equality, and further urge that its

tendency is to degrade military service, which is not true in view of the fact that the soldier renders far greater service than the taxpayer. The reproach that the tax is a tax on cripples is unwarranted; few of the exempted persons can be classed as cripples. Under our law the tax is truly a compensation for the economic loss of those called to the colors, as in years when the troops have unusually long service the tax is doubled.

In France exemption taxes were authorized under the laws of 1800 and 1802, but were soon abolished. A similar tax was levied from 1889 to 1906. Wurtemburg and Bavaria levied such taxes in 1868-9. Germany rejected the system as "fanaticism for equality" in 1881. Austria-Hungary enacted such a law in 1880. Other countries have followed suit—for example, Bulgaria, Rumania, and Serbia.

In Switzerland the tax was levied by the cantons up to 1874, and there was great diversity in the systems. Some even had two kinds of military tax at one time. There were four general systems: I. The tax was paid for a less number of years, by all exempt persons, than the years of service required of the non-exempt. II. The period of taxation equalled the period of service. III. The period of taxation exceeded the period of service, in some cases being for life, and applying to the non-exempt after termination of service. IV. The tax applied also to self-supporting females. In some cases the tax was graded according to the age of the payer, the classification being according to ages for service with the colors, in the reserves, and in the Landwehr. In some cantons the tax was graded according to physical disability, and in some according to incomes.

[The Origin of the Swiss Military Exemption Tax. By Lt. W. A. Immer. *Schweiz. Monatschrift aller Waffen*, Nov, '17. 2200 words.]

The exemption taxes were apportioned in different ways in different cantons: poll taxes, property taxes, taxes apportioned according to the service which would have been rendered by the payer. In some cases the sum to be raised was apportioned equally among the payers; in other cases the exempt were divided into classes, the members of any class being taxed equally. In some cases the tax was paid once, in other cases annually. In some cantons the parents of an exempt person had to give security for his payment of the tax, on the theory that the parents derived an advantage from his exemption. In some cantons lots were drawn for service; of these cantons, some required only the able-bodied to draw, while others required all to draw, and then taxed the exempted defective persons more heavily than the able-bodied persons who had not drawn service. Differences also existed in the grounds of exemption from paying the tax, tho in general those unable to earn a living were not taxed.

As an example, the principal features of the last exemption tax law of Berne were as follows: universal service was required from 20 to 44 years of age. The physically or mentally defective, and government officials were exempt. The son of a widow, or of a 60-year-old widower, a widower with children dependent on him for support, a son living with his indigent parents, were exempt from service with the colors. The morally defective were also exempt. These persons were subject to tax from the beginning of their twenty-first to the end of their thirty-ninth year. Foreigners domiciled in Berne for more than one year were also taxed, unless exempted by treaty. Persons incapable of labor, whose property was less than 6000 fr. in value, or whose income was less than 300 fr., persons injured in service, invalids merely sojourning in the canton, and students not domiciled in the canton, were exempt from tax. The tax from the 21st to the 29th year was 1 per cent on property and 1 per cent on income; half that amount from the 30th to the 39th year. In some cases property in expectancy was subject to the tax.

This law served as a basis for the Federal exemption tax. The Constitution of 1874 gave the Federal government power to make the cantonal exemption taxes uniform, and to appropriate one-half the gross revenue from these taxes. A uniform law was passed in 1875, but it was rejected by referendum. Among features of this proposed tax were the principle of progression in the taxation of incomes, taxation of expectancies in certain cases, application of the tax to Swiss citizens abroad as well as at home for ten years, tho a Swiss who returned after avoiding the tax by residence abroad for the full period of ten service years was not required to pay the uncollected tax.

[The Origin of the Swiss Military Exemption Tax. By Lt. W. A. Immer. *Schweiz. Monatschrift aller Waffen*, Dec, '17. 3200 words.]

The federal law having been rejected by the people, the government tried to collect from the cantons one-half the gross proceeds of the cantonal taxes, as provided by the federal constitution. This attempt was largely a failure. In 1877 the legislature passed another exemption tax law, which differed from the former in that domiciled foreigners whose countries did not require military service were exempted; persons who had served eight years were to pay only half the tax exacted from persons of their age class; the age class from 33 to 44 years was to pay a half tax; the tax was divided into a poll tax of 7 francs and a graduated tax on property and on income. Property held in expectancy was subject to half tax. Farm property was to be assessed at three-fourths its value. Movable property was not assessed. This law was also rejected by referendum.

The first law had been rejected because of the class taxation; the graduation feature caused the rejection of the second.

In 1878 the Legislature passed a third exemption tax law. An attempt to submit this to referendum failed. The features of this (the present law) are as follows: every Swiss citizen who does not render military service is taxed if within military age, whether within or without the country. The same applies to domiciled foreigners unless exempted by treaty, except nationals of countries which require neither service nor exemption tax. The tax consists of a poll-tax of 6 francs, a property tax of fr. 1.50 per 1000, and an income tax of 1.50 fr. per 100. Both movable and immovable

SWITZERLAND—Continued

property are assessed; farm land at 2/3 its value. Property held in expectancy is assessed at ½ its value. The tax continues until the completion of the 40th year of age. Between 33 and 40 years the tax is reduced one-half, and the same is true in the case of those who have served eight years. The minimum tax is 600 fr. The following are exempt: paupers, persons with property valued at less than 15,000 fr. who are incapable of work, Swiss citizens in foreign countries who render in such countries military service or tax; certain railroad and steamship employees; cantonal and communal police; the border guard.

Formerly the cantons permitted those liable to tax to work out the tax by fatigue work around armories and barracks; this has been declared unconstitutional by the federal court as imprisonment for debt. Under existing law non-payment of the tax is punished by imprisonment and ultimately by disqualification for suffrage, and these punishments are not substitutes for the payment.

The cantons receive half the gross revenue, and collect the tax, since the constitution leaves direct taxes to the cantons.

In years when the troops with the colors render unusually long service, as at present, the tax is doubled. It is therefore evident that the tax is regarded as a sort of equalization for the service rendered under arms. As such, it is too small, and should be increased. Further, exempted persons of Landsturm age should pay some tax, as those of such age who are required to serve are at some economic disadvantage even in time of peace. The cantons should pay three-fourths of the gross revenue to the federation, in view of the fact that they are permitted to deduct expenses of collection while employing their ordinary tax-collecting machinery. The principle of leaving direct taxes to the cantons must be given up. The modern tendency is toward centralization, and this tendency must prevail if the country is to succeed in competition with other nations.

TACTICS

See also

AERONAUTICS—TACTICS
ATTACK
CAMBRAI, BATTLE OF
CAVALRY—TACTICS
ENGINEERS—FIELD OPERATIONS
ENTRENCHMENTS—TACTICS
EUROPEAN WAR—FORTIFICATIONS, EXPERIENCE WITH
EUROPEAN WAR—MILITARY LESSONS OF THE
FIELD ARTILLERY—TACTICS
GUERRILLA WARFARE
INFANTRY—TACTICS
INFANTRY—TACTICS—COMBAT
INFANTRY—TACTICS—SHOCK TROOPS
MACHINE GUN—TACTICS
MARCHES AND MARCHING
MOBILIZATION
MOUNTAIN ARTILLERY—TACTICS
STRATEGY

[The Causes of Trench Warfare, and Its Future Possibilities. By Captain of the General Staff Otto Ruge. *Norsk Militaert Tidskrift*, Mar-May, '18. 16,300 words.]

In the introduction the author briefly examines the tendency to trench warfare on almost all the fronts. This characteristic of the war may have its origin in something which is common to all these fronts, and also in the present-day conditions. If this is correct, it will be possible to trace the historical development which has brought about this result.

As a starting point the author takes:

I. The development up to Napoleon.—The theory of of war prevailing, when Napoleon began his great career, was built on the experiences of the great wars in the beginning and middle of the 18th century.

The rectilinear tactics were a result of a long development. The armament of the infantry had steadily been improved, the range and rapidity of fire had been increased, and the fight for supremacy of fire had already become the deciding factor in infantry tactics in the middle of the century. To obtain this supremacy the formation had steadily been made thinner, fighting in three ranks, which could fire simultaneously. This gave a powerful efficiency of fire, which however, was not considered reliable enough to allow gaps in the firing line; the front had to be connected.

The striving for the best possible frontal efficiency of fire led to the simultaneous use of the greatest possible number of units. Reserves, in our sense, were not kept available. The second echelon regularly found in the battles had only the object of filling the gaps in the first line and of keeping up the fire.

The result was a battle formation of two echelons each having long lines of three ranks, the lines of the first echelon being absolutely connected, and of the second connected as far as the amount of troops would allow it.

This formation was a slow moving apparatus; the movements of these long connected lines were very difficult and could be made only to the front. Even a frontal march could take place only in the open field; an extensive movement or an obstacle (creek, swamp, wood) usually broke up the formation. More extensive changes of front caused the greatest difficulty.

In short the infantry was only good for frontal, stationary fighting. Its efficiency of fire in a frontal direction was very great, its striking power little, and its capacity of maneuvering almost none.

The artillery was not able to neutralize the shortcomings of the infantry. Change of position was seldom made during battle on account of short range, slow fire, and heavy weight of the ordnance. As it could not shoot over the infantry, it had to be placed on the flanks or in front. On the flanks it was exposed to capture by hostile cavalry or light troops, wherefore it was, as a rule, placed in front of the infantry with the result that it had to suspend firing as soon as the infantry had moved forward. Hence the artillery had little influence on the result of the battle, especially for the attacking side.

The cavalry went thru a rapid development. It moved during the first part of the century at a foot pace and trot and readily interfered in firing; from the middle of the century its movements became more rapid and aggressive, readily attacking at the quickest pace. All the time it kept its place on the wings

of the infantry, covering its own flanks and taking up the battle against the hostile cavalry. Having defeated the hostile cavalry, it could turn against the flanks of the hostile infantry and sometimes decide the battle. Any independent cavalry operations were seldom seen; the cavalry stuck to the infantry.

Like the infantry, the cavalry needed open ground for its attacks in long, closed lines. It had to form before the battle and was never wholly suited for independent operations.

The armes of the 18th century thus had not risen above the prearranged battle order. A real direction of operations was very difficult. Maneuvers and regroupings during the battle were seldom effected. The result of the battle depended upon the success of the single units against the adversary immediately in front of them.

The battles were parallel battles where the infantry fire was most important and where the defense had the best chances. A brook, a group of trees, etc., became a formidable frontal obstacle on account of the disorder which it caused in the formation of the attacking troops. A field which was difficult to pass in close formation was practically useless for a battle.

On account of the rectilinear formation, almost all the troops became simultaneously engaged at short range, the powerful frontal fire causing great losses. The leader of the battle had little influence on the result, and could little utilize a victory. The lack of reserves and inability to maneuver seldom allowed an effective pursuit. Hence many leaders only reluctantly gave battle.

The troops were not suited for fighting outside the closed formation in which they were exclusively trained. Fighting in scattered formations was little taught. In war times the light or irregular troops were doing scout and guard service, taking part in guerrilla warfare, etc.

During the Seven Years' War, there was some development of tactics. The great efficiency of drill of the Prussian infantry made it, to a certain extent, possible for them to maneuver in battle formation, to execute flanking movements, and to maneuver on more difficult ground. Frederick II could thus combine frontal and flanking attacks in maneuvers in battle formation; but even he did not rise above the notions of long, continuous infantry lines and the necessity of forming before battle.

As the old troops of Prussian infantry were diminished and substituted with new elements, the standard of the drill became lower. The adversaries never reached the efficiency of Frederick's maneuvers. The triumphs which he sometimes obtained with his oblique

The endeavor to find new, more aggressive tactics by improving old methods of drill did not lead to great results. As a recompense, some liberation from the stiff, connected battle formation was gained. As the frontiers between Prussia and Bohemia and in Central Germany are very wooded and mountainous, a connected formation of the army could not take place during the battle. The army was divided into several columns which ,on account of the difficult ground, had to fight without direct connection with the neighboring groups.

The French Marshal de Broglie drew certain conclusions from this fact, and divided his army into independent divisions which, however, kept the usual battle formation. When the war was at an end, the old tactics were again mostly adhered to. The war in the wooded parts of the country brought a more extensive use of light troops and a scattered formation. This fact, however, did not exercise any decisive influence on the organization, training and theories of war of the coming age.

The influence of artillery was increasing during the wars. The number of guns was increased and they were made lighter and more mobile. Frederick II introduced horse artillery, and allotted a part of the artillery to the infantry brigades permanently. The artillery now participated in the whole battle on account of the division of groups. As a permanent result of the development, the artillery kept the division into tactical units (batteries) after the war. But the development of the artillery did not, however, result in any decisive influence on the tactical ideas of the war. These remained the same as before the war.

Tactics has an essential influence on the conduct of a war in its entirety, but is not alone deciding. Several other factors, like the geographical and economical, play an important part.

In the first part of the 18th century Europe was a poor continent, especially its middle and east parts, which were the scenes of the biggest wars. The densely wooded country, full of swamps, was little cultivated. The towns were small, lacking industries. The main part of the people did a little farming, not in order to sell their products, but for their own needs. The farming did not give any surplus of products, and famine was certain if the crops failed. The buildings all over the country were poorly constructed. The small villages usually consisted of poor huts. The capacity for billeting was generally very limited.

The communications were worse still. Up to the middle of the century there were no built roads in central and east Europe. The main communication even between the larger towns were natural roads, impassable during rain and the wet seasons. There were few bridges; ferries and river crossings were unusual, even on the main roads. The country roads were mostly riding tracks or old wheel tracks between villages.

This primitive state of things necessarily put its stamp on the mode of warfare. The armies could not live upon the country as they did later. An attempt to supply a concentrated army by requisition within the territory of the concentration would have brought a complete devastation of that part, and even then it could be thought of only for a few days. These circumstances made it necessary for the troops to live in camps and to be supplied by a quartermaster. An extensive camp material was necessary, which again needed a numerous train.

When the army was not engaged in fighting it was supplied from stationary or temporary depots which

TACTICS—Continued

were filled by requisitions and purchases far around the camp. On the move the train had to provide for supplies either by carrying them or from depots in the rear. This required an enormous train, and the army could go only so far away as the ability of the train to maintain the lines of communication would permit. The supply service was very well attended to, and was finally systematized.

The bad roads limited the liberty of movement of the army, and the necessity of maintaining regular connection with the depots made the lines of communication very vulnerable. This prevented a rapid offensive and made obstructions of the roads (positions) and enterprises against the lines of communications of the enemy very valuable means of combat.

This slow and methodical mode of warfare was accepted by most of the contemporary generals and military authors as the only correct and necessary system; only a few felt it to be too cumbersome and tried to break away from positions and maneuvers in order to conduct the war more rapidly and aggressively.

Among these Frederick II is the greatest.

Frederick II, in the Seven Years War, fought against a coalition of states, together commanding far greater resources than himself. To be victorious, he would have to operate on inner lines and try to attack and defeat each adversary singly, before they had time to unite. Qualitatively his armies were so superior to those of his enemies, that he could, better than anybody else, dare to take the offensive. Whenever it was possible, he broke away from contemporaneous methods, utilized all the resources of the theater of war, and daringly risked his lines of communication. However, his mode of warfare does not differ from the usual one, only that his campaigns were later used as an example of how a methodical position and maneuver war ought to be and was possible to conduct with advantage.

The 18th century conception of war, given here in a short and simplified form, had no theoretical basis; it was built on the experiences of the time and was, in the main, well founded. But it did not consider the new possibilities shown by the war as anything but exceptions due to special circumstances, not likely to occur during another war. In this it was, however, wrong; in fact, it offered possibilities for the development of freer forms, of which a later age was privileged to take advantage. It was in the field of tactics that these new theories made themselves felt at first.

During the Seven Years War, Marshal de Broglie, realizing the inefficiency of long, continuous lines for the offensive, tried to form the army into permanent units (divisions), and sought to make it more mobile also in other ways; in other words, the line was to be replaced by the more mobile column. After much wrangling, new tactical forms were elaborated at about the time of the revolution.

The infantry formed permanent divisions and were given simplified rules of drill which allowed a rapid change from marching to maneuver formation (column) and from that to fighting formation (line). These new formations gave the infantry the suppleness which it had been lacking hitherto, and made possible maneuvering on almost any kind of ground.

More weight was given to the deployed formation, which had always had its supporters in France. The experiences from the North American war brought it to the foreground, and when the French revolutionary wars began, lines of infantry, as a rule, commenced the battle, covering the maneuvering columns and fighting independently on less important parts of the front.

Simultaneously the field artillery made considerable progress, the technical outfit becoming better, the material lighter and the fire more rapid. More weight was given to tactical training after the division into batteries.

In the course of half a century the heavy artillery parks of the Seven Years War passed to a mobile, partly horse and partly field artillery, which could follow the infantry on all kinds of roads and ground without great difficulty. The column tactics opened new possibilities for the artillery, allowing maneuvers between the scattered groups of infantry and firing up to the last moment; it became the support of the storming attacks of the infantry and the important arm which it has been ever since.

But also in other fields possibilities were opened for a freer mode of warfare. Times became more prosperous during the latter part of the 18th century, especially in Central Europe. The population increased, industries were rapidly developed, and the economic situation was improved. Farming and breaking up of new land kept pace with it, and the improved economic situation led to better construction of dwellings in the country. Finally the means of communication were greatly improved.

The latter part of the 18th century was a peaceful one for the European continent. There were no great wars, and consequently the war theorists continued building on the experiences of former wars, and the Seven Years War. While some daring theorists, like the Frenchman Guibert, predicted a revolution in the art of war, the great bulk of military authors contended that the old, tried methods were, and were going to remain, the best.

II. The Time of Napoleon. The French Revolution resulted in a period of war which extended over 20 years. The first years brought little new in the domain of conduct of war. One followed the theories learned during peace.

By and by the new theories were breaking thru. The division tactics had made the old fear of gaps in the front disappear. It led, however, to an almost indefinite prolongation of the front. The battles were still parallel, all divisions being placed at the side of each other on a heavy front; positions were taken (held) to a far greater extent than before.

The French revolutionary government was not able to provide its armies with a complete camp and train outfit. Bivouacking and quartering had to do, and when the quartermaster had not been able to provide for supplies, the troops took what they found on the scene of war. But to utilize this independence of train

and supplies for more rapid war movements was not thought of.

Then came Napoleon. He did not create anew the elementary tactics; the French infantry had the same rules of drill in 1815 as in 1791. He did not introduce any essential technical improvements. His merits were the discovery of the possibilities of the new development, his brilliant utilization of them, and his genius for organization.

The old defensive positions became useless. Even if the pure frontal attack scarcely had better chances than previously, the new tactics favored the offensive just as much as the previousl recilinear tactics had favored the defensive. The general of the offensive might now confidently offer battle in view of the superiority of his operations, if the forces were nearly equal. The chains of the position warfare were thereby broken.

But Napoleon did not need to attack strong positions. If one way was blocked, he could choose another, the means of communications being so much improved, and continue his march into the heart of the country, until his adversary finally was compelled to give battle where it suited Napoleon. Difficulties in supplying the army could not stop him either; the theaters of war were too rich and the mobility of the armies too great. Of this Clausewitz says in a chapter ("Vom Kriege," 5th book, 14th chap.) about the supply of the army: "In a well populated country an army of 150,000 men in close formation may live upon a territory for one or two days, consequently such an army may be supplied during a continuous march without the aid of depots or special preparations. On this fact the operations of the French armies during the wars of the revolution and Bonaparte were relying. They penetrated from Etch to the lower Danube and from the Rhine to the Weichsel without having very much more supplies than what they found in their quarters, without suffering want of food. As their enterprises were founded on physical and moral superiority, followed by undoubted luck, and at least never were detained by hesitation and prudence, their victories took place during a continuous march."

Napoleon did not form his mode of warfare into a system. None of his generals were able to follow in his footsteps. His adversaries arrived at an understanding by and by, but nobody dared to imitate him. The distance between his genius and common mortals was too great.

Later, however, his contemporaries liberated themselves from the old theories and adapted their conduct of war to the new ideas. When the long period of war was ended in 1815, the new mode of warfare was accepted by all.

III. The Theories of War of the 19th Century.—The first half of the century did not bring much of novelty into the military world. The wars were few and the interest in military matters was waning. Only in the middle of the century there was a change; about 1850-60 some technical improvements were made, which were destined to have a great influence on the development.

The infantry was furnished with rifled bore, breech-loading firearms, which had a longer range and were more rapid firing than before. The line of sharpshooters soon became the only form of fighting of the infantry, while the battalion column disappeared from the battlefield. The first line of sharpshooters ran forward from cover to cover while the remaining lines followed in company columns, also utilizing the cover of the ground.

The battle fronts became more extended and the battles long-continued. The artillery also became more rapid in firing, more accurate of aim, and of longer range. It was placed in long lines at a distance of 2000-3000 m. from the enemy, shooting over the heads of their own infantry.

The explosive force of the artillery projectile increased. The former constructions for protection lost their efficiency and finally disappeared. The infantry sought the natural cover of the ground in a prostrate position.

The cavalry could not make itself felt any longer on the battlefield. The improved firearms makes it possible even for a thin line to stop a cavalry attack. As previously, these technical improvements were not fully accepted everywhere. Only in the great wars of 1866 and 1870-71 the Prussians under Moltke had known to utilize them to their advantage.

The wars of Moltke were conducted under very favorable circumstances. His armies were superior to those of his adversaries both in quantity and quality. The hostile generals and troops had not adopted the new ideas, at least not to the same extent as the Prussians. None of them dared an offensive or to utilize the possibilities of the new tactics for the defense. The battles were battles of rencounter, and Moltke's armies, marching forward on a broad front, attacked anywhere and at any time that they met with resistance. The battles took place in the best cultivated parts of Europe. The only time Moltke met with difficulties of ground (marching into Bohemia in 1866), only part of his forces met with some resistance.

His operations were, like those of Napoleon, not hampered by difficulties of communications and supplies. Moltke had had a special interest in the railways which he knew how to utilize.

The tactics and strategy of Moltke are somewhat different from those of Napoleon. Moltke's strategy is simplicity itself, but lacking the brilliancy of that of Napoleon. The decision was, as a rule, the result of his disposition of his troops before the battle and the advance on a broad front, his wings outflanking the enemy. Moltke's conduct of war is built on the ideas of Clausewitz.

Of those who have tried to derive the theoretical foundations from the conduct of war of the time of Napoleon, Clausewitz has had the greatest influence on the conception of warfare of our times.

Other authors have tried to fathom Napoleon's combinations by dissecting his operations by steps, etc., which should not be undervalued. But the distance between the brilliant and the ordinary is too great to allow the building of a general theory of war on the happiest strokes of a genius.

Clausewitz employed another procedure. He tried

TACTICS—Continued

to find the factors which Napoleon (and other great generals) had considered most important, the so to speak eternal fundamental laws of warfare, not its fine points. Hence the basic importance of his work.

The fundamental tenor of his reflections may be summed up thus: The object of any war is to compel an adversary by force to do what he cannot be induced to do by peaceful negotiations. The surest means is to attack and destroy his armed force. This done, the rest follows by itself. Hence the offensive against the most important forces of the enemy is the most rational form of the war. Everything else, the occupation of territories, taking of forts, destruction of supplies, is of secondary importance (either as a result of the operations against the hostile main army or as a preparation for these) which may not divert troops from the main operations. The main point is the concentration of forces on a decisive point (relative superiority), where a victory annuls the consequences of bad luck of secondary operations. Offensive and concentration—in place, time and object—is to be striven for primarily.

These properties characterize the wars of both Napleon and Moltke.—But Clausewitz does not stop at these general reflections. He goes further and investigates to what extent these basic ideas might be applied to the state of things in his time in the middle part of Europe, arriving at the result that he might do so favorably. The most probable scenes of war were large and traversed by roads, and the troops in relation were few. A battle was an action of some duration varying with the strength of forces—from some hours to some days. Under the circumstances, Clausewitz says, the issue is to combine in time and place, to place the operative units in such a relation to each other that they control as large a part of the battleground as possible, and at the same time are not further away from each other than to allow them to support each other in the decision of the battle. The victor will be the one who has most rapidly concentrated a superior force on the battlefield, provided that he otherwise possesses the condition for victory: tactical efficiency and moral superiority.

Clausewitz considers the last of the greatest importance; he attaches, on the contrary, little weight to the nature of the strategical combinations, outer or inner lines, frontal forward march or flanking movements; it is all the same to him, only it leads up to one thing, the battle concentration, with superior forces, against an inferior (relatively) enemy. The combination ought to be so simple, that unforseen circumstances (frictions) would play the smallest part. The defensive, according to Clausewitz, also has its great advantages; it does not, however, force a decision—it delays it and leaves the decision to other factors (time, economical or political circumstances).

"The defensive," Clausewitz says, "is the stronger form of fighting, but with a negative aim; the offensive is the more risky (weaker) form of fighting, but with a positive aim."

Moltke and his army were brought up in the spirit of Clausewitz, the results indorsing the truth of his statements. On the basis of Napoleon's and Moltke's campaigns a more and more one-sided view of the offensive, the strategical as well as the tactical, was developed, as the only or the most desirable mode of warfare. His reflections over the defensive were ignored. The fact that Moltke had emphasized the advantages of the defensive was so much the more easily overlooked, because he had never practiced it himself.

Tho the battles of 1866 and 1870-71 had proved that the new firearms had made the frontal attack more difficult, thus far favoring the tactical defensive, this circumstance had become less noticeable, because the rapid flanking movements had always decided the battles before the frontal fighting had reached its critical stage. Much importance was not attached to this fact, either.

Now an exaggerated kind of offensive tactics was developed on the training fields and in the maneuvers, which in place of a suitable name may be called "Entfaltung tactics." Its main features were:

When two adversaries are presumed to be on the offensive, their forward movement will lead them to a collision (battle of rencounter). During this the issue is to gain the upper hand, to force the adversary into the defensive, to involve and to hold him by a powerful frontal attack and to begin a flanking movement, so that he will be defeated before he has time to make any countermove. Time must not be wasted in changing formation or reconnoitering; the advance guard evolves at once, the artillery trots forward and opens fire and the infantry behind forms in line directly from the marching column (Entfaltung).

[The Causes of Trench Warfare, and Its Future Possibilities. By Captain of the General Staff Otto Ruge. *Norsk Militaert Tidskrift*, June-July, '18. 1000 words. (Continued.)]

In Prussia the reserve artillery, in view of the experiences of 1866, had been distributed to the corps, and later the corps artillery to the divisions. Development took the same direction in other countries:

The general does not interfere with tactical dispositions on the battlefield; these are left to the chiefs of corps and divisions. The general makes the distribution (grouping) of the units before the battle.

Possibly the view of peace tactics previously given is a little exaggerated. Nobody could be blind to the possibility of other forms of warfare. Especially in the years before 1914 position warfare was studied and practised. But the rencounter battle and the rapid evolution of the fighting remained the main theme for the exercises. Peace tactics, however, do not correspond to the exigencies of war, just as little as the war itself took the aspect which was expected.

IV.—Deviations From the Prevalent Mode of Warfare in the 19th Century

Not all of wars of this century were offensive with quick decisions. The war of Crimea began with an attack on the coast fort Sebastopol. The land fronts

of the town were weak, and the western powers were under the impression that they could be taken by assault. They found these fronts stronger than expected; they feared to surround the town on account of the presence of a Russian relief army farther in the country. The strong positions of defense tied the aggressor, so that there was no other way for him than to continue where he had started and to attack the front where the defense was strongest.

The Danish war in 1864 was mainly a fight about fortified positions. The scene of operations was so narrow that the Danes could find and hold defensive positions across it, first Danevirke which barred the roads of advance, then the flank position of Dybbol, which threatened the German line of communications, if they would dare to pass and march into Jutland. Both positions were attacked and a regular fight in fortified positions developed. Danevirke was evacuated before the storm, being too extended in relation to the Danish forces (length 50 km., or 80 km. including Slienfiord, forces about 35,000 men against 55,000 Germans); Dybbol was taken by storm after a careful artillery preparation and in a way very similar to that of our time. The firearms used are long since antiquated; tactically it would be dangerous to derive a lesson from it, and strategically it may be pushed aside as an exception. The Civil War of North America (1861-65), unlike the war of Crimea and the Danish war, took place on a very extended scene of operations. The contending armies were numerous; arms and technical means were fully up to the exigencies of the time. In many ways the war was even epoch making in the field of military technic. Economical considerations did not hamper either of the sides. Even if the leadership sometimes was a little amateurish, many of the leaders were able men with a solid military education; some of them, for example the Southern General Lee, were high above the average.

The assertion, so often made, that the war would have taken another course and the experiences would have been otherwise, if the war had been fought with European troops, is only correct to some extent; but it loses not so little in the light of the experiences from the present war.

All in all it may safely be asserted that the American armies at the end of this Civil War were about as good as the armies now fighting in Europe. (The author now describes the operations of the Civil War.)

Contemporaries were little inclined to draw far-reaching conclusions from the war. More attention was paid to the more known and brilliant campaigns which Moltke was simultaneously conducting in Europe, and one was inclined to push aside the experiences of the Civil War, referring to the quality of the troops and the exceptional circumstances on the battlefield. Even if several of the more prominent military authors, among them Moltke himself, paid great attention to the Civil War, it had little influence on the military opinion of Europe. The same thing occurred in the Russo-Turkish War (1877-78). The troops were, as a whole, equal to those of the other European armies; the generals were not very prominent, but had received the usual European education of officers and were not below the average. The scene of operations was poor, the ground difficult and the communications of the aggressor with the home country very bad; hence one must be careful in drawing conclusions from this war in comparison with other campaigns.

The main operations were centered on the crossings of the Balkans; after having crossed the Danube without resistance, a smaller division under Gurko was sent across the Balkans to Bulgaria. As a Turkish force under Osman Pasha had penetrated to the northwest into the Balkans and was threatening the Russian line of communications (the bridge over Danube at Simnitza), Gurko was called back and the operations of the Russians were concentrated on repeated attempts to push Osman Pasha back from his strong flank positions at Plevna, which were all defended; in December, 1877, he surrendered on account of lack of food.

The four wars mentioned here have shown that a defender in a strengthened position could offer such a powerful resistance even to a superior enemy, that it could hardly be taken, in any case not without tremendous exertions.

At Danevirke, Dybbol and Sebastopol the defense was based on fortifications constructed during peace, even if the main work of strengthening was performed during the war; at Richmond-Petersburg and at Plevna all the works of defense were executed during the operations and the positions were improved as the aggressive power of the enemy was increased. In this race the means of the defensive were developed parallel with, even quicker than those of the attack. Relatively the positions were stronger and more impregnable at the end of the battle than at the beginning.

In Denmark and on Crimea, the fortifications were constructed according to older ideas and were finally destroyed by the attacking artillery. In America and at Plevna the fortifications were modern, being sharpshooting trenches adapted to the ground and the tactical situation. The attacking artillery did not have the same effect as against older fortifications, and the infantry could hold its own even under violent artillery fire, repelling every attack.

The experiences from these wars confirm Clausewitz, who says: "To attack a strong enemy in a good position is a bad undertaking." But he adds that "this must not be mistaken (fights about fortified positions) for common battles. Most battles are battles of rencounter, where one part is standing in a position, but not in a prepared one."

In this respect the wars, especially in North America and in the Balkans, showed symptoms that the development was making the foundations of Clausewitz's optimistical theories crumble. A position prepared not at all or only a little was a hard nut to crack in a frontal attack, and the extended battlefronts made flanking difficult and less effective. The tactical chances of the offensive were diminishing.

In fact, this was also noticed in the Franco-Prussian War. But when Moltke's battles were decisive and brought important results, this was due to his dispositions before the battle, which brought about the flanking as an immediate and direct consequence. This previous grouping and advance on a broad front was, how-

TACTICS—Continued

ever, possible only because of the greatly extended scene of war, the rich supply of provisions and the well developed net of roads, which gave his armies sufficient liberty of movement.

In Denmark, America or in the Balkans, the battleground did not give such liberty to the armies; instead of short battles of rencounter there were battles about positions and maneuvers around the most important geographical objectives (railways, crossings, mountain passes). The first wars of the 20th century were going to confirm these experiences still further.

V.—The Wars of the Last Part of the 19th Century and of the Beginning of the Next

The last part of the 19th century had brought important changes in the technique of arms, namely the magazine gun and smokeless powder.

The rapidity of fire and the range of the artillery were continuously increased. Simultaneously it passed from the use of grenades to that of case-shot. This last change was a consequence of the tactical opinion of the time, presuming the battle of rencounter to be the rule. In such a battle the destruction of cover was supposed to have a secondary importance; the main thing was to put as many men out of action as possible and to combat the unprotected sharpshooting lines. The change of armaments had a great influence on tactics.

The new arms were used at first in some small wars in the nineties, the Serbian-Bulgar, the Greek-Turkish and the Spanish-American wars; they did not, however, contribute to make the tactical effect of the arms clear. There was, however, an instance in theSpanish-American war which is of a certain interest for this article: the battle of Santiago.

Santiago was fortified towards the sea front, but not towards the land fronts. An American corps therefore landed with the objective to take the town from the land side. They penetrated without difficulty to the outskirts of the town, where they encountered Spanish fortified field positions covering the whole east side of the town. The positions were constructed behind some clearings in the forest, and they consisted of trenches which, for the first time in the history of war, were protected by barbed wire fences.

In front of these positions the Americans were stopped, a frontal attack was defeated, and the lack of roads and means of transportation prevented them from flanking, even when the left wing of the position was hanging in the air, so to say. The situation was very like that of the allies in front of Sebastopol. It was not developed, however; the Spaniards, lacking munitions and supplies, gave up the defense of the town.

The first big war to be fought with the new arms was the Boer War (1899-1902). It was fought under peculiar circumstances and neither of the sides was equal to the best European armies.

The Boers were good shots, mobile and understood how to utilize the ground, but they were not disciplined, not organized and lacked the initiative to utilize the opportunities of seriously defeating their enemy. Theirs was a passive defense. The tactical training of the English was antiquated and their organization lacking.

In spite of this, this war caused a violent discussion in the mliitary world. Some drew very far-reaching conclusions from it and predicted an entire revolution in the mode of warfare, while others denied its importance in view of the abnormal circumstances. Now it is easier to judge it objectively. The war confirmed that it is very difficult to attack frontally a position with a free range and a defender who understands how to utilize the position and the peculiarities of the ground. Modern firearms and smokeless powder here give great advantage to a defender, and allow him to extend his front almost indefinitely. The field artillery with its case-shot was of little effect against trenches or positions. Finally it showed the usefulness of heavy artillery also in the field on account of its greater efficiency against positions and its longer range, the advantage of which the enemy must try to annul thru acquiring similar guns.

On the other hand, the war did not give any answer to the question whether, on the whole, it was possible to make a frontal attack, because the frontal attack of the English was too faulty. Later in the war, when they had acquired better tactical form, they did not make any serious effort to attack positions, but contented themselves with maneuvering.

The more sober criticism reproached the English for this. That a frontal attack is difficult, is a matter of common knowledge; likewise that a badly executed frontal attack is bound to fail. But the main object of a frontal attack in our days is to tie the enemy up in the front and to compel him to employ his strength there; the decision will then be forced thru flanking which the enemy cannot meet, because his troops are already engaged in the front. The English, never threatening the hostile front seriously, could not expect the flanking to bring about a decision. Finally, it showed the reason the attacking artillery had little or no effect: the artillery fire and the infantry attack were conducted as two isolated parts of the battle, the artillery first bombarding the positions, sometimes for a day or two, the infantry going to attack afterwards. In this manner the defender could remain under cover during the bombardment and occupy their positions as soon as the infantry was advancing and the artillery fire diminished or stopped. The infantry ought to advance before and during the bombardment which ought to be continued during the whole infantry attack. As a new problem the co-operation between the artillery and the infantry arose. Later wars would show how it was done.

The next war, the Russo-Japanese (1904-1905), the experiences of which were discrepant from those of former wars apparently, took other forms. The Japanese were well educated in the offensive and had a modern training, based on the experiences from the Boer War and their own first battles. Where the ground did not offer cover their infantry advanced in scattered formation, if necessary carrying a spade; their artillery, in the meantime, kept the Russian infantry down and engaged their artillery. In this manner the infantry advanced within effective range, where they opened fire, still supported by their artillery. The rear lines presently advanced, filling up the front line

until it was very thick. Having gained fire supremacy, the line advanced in smaller and larger groups, still supported by their artillery, until storming distance was reached.

In spite of this mode of attack the resistance was not broken. As a rule the storming forces were repulsed: Should they succeed, they were, as a rule, driven back again by a counter attack of the Russian reserves. In case of a success it was only a local one and the conquered position could not be extended to the sides; a penetration of the lines was out of the question. In reality, this war confirmed the experiences from the Boer War as regards the frontal attack; the enemy was not made "Strumreif," as the Germans say.

To attain this object the Japanese developed the technical forms for co-operation between the infantry and the artillery and employed, to a steadily increasing extent, the concentration of artillery fire against limited parts of the front. The heavy artillery as well as the field artillery was greatly increased; the brisant grenade was used to insure better effect against the infantry in the trenches. But the frontal attack still remained a problem to solve. To escape fire night attacks were executed, which, however, only brought local successes.

The defenders also made improvements. The profiles of the trenches were made stronger and were connected with each other, thereby making it possible to hold the line as such, even if part of the first line was taken. Obstacles were employed, especially barbed wire, which resists artillery fire efficiently. Also the mitrailleuses were a valuable means of defense. The circumstance that the defensive artillery is wholly or partly hidden and difficult to put out of action is very important.

The Japanese did not, however, conduct any of their battles as pure frontal attacks. Contrary to Lord Roberts, who substituted the combined frontal and flanking attacks for flanking maneuvers, the Japanese acted according to the opinion of the time: engaging the enemy in the front, while flanking his wings. To be honest, they did not achieve more by their operations than Roberts by his. The combined frontal and flankin attacks of the Japanese were founded on the same ideas as those of Moltke, but their execution as well as their result was very different.

On the 2nd of July, 1866, the Prussian troops, about 225,000 men, were standing in a bow 30 km. long west and north of Königgrätz, where the Austrians were concentrated with an equal force. Next morning Prince Friedrich Carl attacked the Austrians (frontal attack). At noon the same day the Crown Prince of Prussia attacked the Austrian right wing, in the evening the battle was decided and the Austrians retreating to Olmutz, 120 km. away. The battle of Königgrätz decided the war.

On the 29th of August, 1904, the Russians were standing south of Liaoyang, about 150,000 men strong, on a front of 25-30 km.

The Japanese, coming partly from the southwest and partly from the southeast, after having driven back the Russian advanced guard, stop close to this front with a somewhat smaller force, but with superior artillery. Both parties have divisions echeloned towards the east in the mountains east of the railway. On the 30th and the 31st the Japanese make a frontal attack without advancing much. In the evening of the 31st the Papanese reserve (1½ divisions) march to the north against the Russian right flank. Simultaneously the Russians abandon their projecting position and fall back on a 15-20 km. long line of defense immediately in front of Liaoyang.

The following days (1-3 September) the Japanese right wing (Kuroki) marches northward for another flanking movement, while the rest continue the frontal attack. The Russians continuously extend their lines to meet the Japanese flanking movement, prolonging their lines 20 km. to the north (to Yentai). The Japanese flanking movement is slow; the Russians escape in time without greater losses. They take up new positions at Shaho, 40 km. north of Liaoyang, and remain here unmolested a whole month, until they themselves start an offensive, in which they do not gain anything.

The result of the 5 days battle at Liaoyang is then only a short Russian retreat; while the short battle of Königgrätz, under the same circumstances, decides the war.

The pursuit took the same course without resulting in a catastrophe; effective pursuit never takes place on account of the exhausted state of the troops. The defender is always given time to retire and reorganize in a new position. The result of half a year's victorious battles for the Japanese is the retreat of the Russians of 70 km. straight back without suffering greater losses than the Japanese themselves; each time they have to evacuate one position they occupy a new one immediately behind.

So far the operations in Manchuria are of the same nature as those of North America and South Africa.

VI.—Attempts to Improve the Conditions for the Offensive

The war in Manchuria differed very much from the ideas formed in Europe of the future war. Among the causes of its slow course may be mentioned the equal force of the armies, the predilection of the Russians for fortified positions and their stubbornness in the defense, the exaggerated prudence of the Japanese leaders, and other faults of the leadership on both sides. But after a better knowledge of the real course of the operations had been arrived at, these causes were given less weight, and the criticism stated three main causes for the slow and indecisive course of the operations:

1. The new armaments make the attack slow and offer few chances, even against a relatively weak position.

2. Flanking movements lose their value as a tactical means as the armies are increased.

3. The bad means of communications, the difficulty of getting supplies, the long lines of communication on the scene of battle made it impossible to execute rapid movements of troops and particularly difficult flanking movements; these circumstances as a whole had a paralyzing effect on the operations. The author mentions a fourth reason, not so often referred to, but nevertheless of a certain importance:

TACTICS—Continued

4. The territory where the decisive operations were conducted was too small for strategical movements.

Of the four factors above mentioned the latter two would be negligible, according to general opinion, during a war in Europe.

The causes of the first two might be eliminated thru:

1. Increase of the technical means of the attack: increase of the artillery, especially the heavy and other ordnance, use of more powerful brisant grenades, and increased munition supply.

This development was, however, partly neutralized thru a corresponding development of the technical means of the defense: mitrailleuses and artillery fire from hidden positions.

2. Further development of the detailed technique of the attack by adequate forms for the infantry attack (utilization of the ground, open order, use of the spade during attack).

These new forms met with some opposition, however, because it was feared that it might oppose—

3. The development of the moral means of attack—the spirit of the offensive.

The best means of developing the spirit of the offensive was thought to be the tactical exercises to which great importance had been attached hitherto—the so-called "Entfaltungstaktik" previously mentioned.

To neutralize the inconveniences of the large battle fronts one sought

4. To develop the technical means of the leadership (telegraph, telephone, signalling, automobiles, etc.) so that the leader of the battle could follow the course of the battle even in a large area.

5. To increase the mobility of the troops (better marching achievements, lighter equipment, bicycle divisions). However, the exigencies for increased technical equipment and a surer way of supplying provisions (among other things movable kitchens) were in the way. The mobility of the troops became less rather than greater.

6. To find forms for battle tactics which would agree better with the new means of combat and the increased troop masses. There are two different points of view in this matter. A further development of Moltke's ideas is the first one, where the flanking movement brings about a complete surrounding and destruction (Cannae battle). The second view is contrary to the first one; the extension of the fronts will lead to a weakening of the line and will favor a penetration which may bring about a decision more effective than the flanking movements.

The partisans of these ideas liked to call them a direct continuation of the tactics of Napoleon—"je m'engage partout et puis je vois"; the warmest supporters of them were the French, while the contrary direction was general in Germany, where it found its perhaps strongest expression in the known reflections of the Chief of the General Staff, Count Schlieffen, over "Cannae."

VII.—The World War

Both points of view just mentioned are justified, provided they can be brought thru in practice. A well planned and rapidly executed flanking movement under favorable circumstances may lead to great results (the summer and winter battles in Masuria) as well as a successful breaking thru, when the occasion offers it (Dunajetz, Tolmein).

In spite of all the efforts to escape a mode of warfare like that of Manchuria, the trench warfare of the world war has taken forms more extreme than at any time during the 19th and 20th centuries. The reason is found in the historical development described previously.

The wars of Napoleon mark the brilliant culmination of the offensive open warfare. Before his time the wars are position and maneuver wars, and after his time the mode of warfare slowly but surely sinks back to the same standpoint. The three factors previously mentioned which formed the basis of Napoleon's conduct of war, viz., the technique of arms and tactics allowing the decision of a battle in a short time, the mobility of the armies, the condition of the scene of the battle, made Napoleon's operations possible; the lack of efficiency in these directions had prevented Frederick II from gaining the decisions which he wanted from his operations.

All these factors had changed during the course of the 19th century. The defense had grown stronger, the attack slower and the battle fronts larger; the rapid and surprising decisions disappeared. The armies are not so mobile as formerly. Napoleon's divisions of 8000-10,000 men, later corps of 15,000-25,000 men, with a limited amount of vehicles and a small train and few non-combatants, have now grown to corps of 42,000 men, 15,000 horses and almost 2700 vehicles. Fighting men in the latter less than 2/3, against 5/6-6/7 in Napoleon's armies. The length of the column of the fighting troops of the corps was increased to about 27 km.; baggage and large train included, its length was over 53 km. For a day march of 20-25 km. and then form for battle, the fighting troops of the corps corps. And in spite of all, this heavy apparatus has need 20-24 hours, or double the time of Napoleon's far less offensive power than one of Napoleon's corps, when one takes the increased power of resistance of the defensive into consideration.

Simultaneously the army corps has lost in value as a battle factor, relatively seen. Napoleon effected most of his campaigns with 6-8 corps, while the Germans invaded France in 1914 with a number of corps—somewhat differently stated—between 33 and 45.

Finally there is the third factor, the condition of the war theater. They are many and very different: for this article it is of most interest to look into the conditions of the richest scene of war—the west front.

In 1800 France had 27 millions of inhabitants, in 1914 39 millions; for Belgium the corresponding numbers are 3 and 7½ millions, for Germany 25 and 68 millions. The population of France had then increased 1/3, while that of the other two countries had more than doubled since the time of Napoleon. This increase was mainly due to the strong growth of the population of industrial towns; in the territories, where the battle of the west front now is raging, the peasant population

had not increased to any greater extent during the last 100 years.

At about 1800 the produce of these territories was sufficient for local needs; in 1914 they had to import foodstuffs. In 1914 the armies had to bring or carry supplies, consequently, a condition like that of the 18th century.

The means of communication have developed to quite another standpoint. The railways had been substituted for roads, which had been reduced to serve the local traffic; the automobile traffic had not changed this circumstance to any great extent. Hence the development of the roads had been neglected; during the last half of the century comparatively little had been spent on roadbuilding in Middle Europe.

—Artillery

See also

FIELD ARTILLERY—TACTICS

MACHINE GUNS—TACTICS

—Cavalry

See

CAVALRY—ORGANIZATION—SWITZERLAND

—Defensive

See also

INFANTRY—TACTICS—DEFENSE

—Field Service—Attack

See

INFANTRY—TACTICS—ATTACK

—Grand Tactics

[Use of the General Reserve in Grand Tactic Maneuvers as Illustrated in the Russo-Japanese War. By Col. W. A. Mitchell, C. of E. *Professional Memoirs,* Jan-Feb, '18. 8000 words. Maps.]

The student of history is apt to spend his time on the strategy of campaigns to the exclusion of the tactics. Officers are usually much more familiar with the strategical errors of the commanders-in-chief than with the tactical errors of the commanders or their subordinates. It is well for officers to devote the greater part of their time to the study of tactics. Not one in a thousand will ever be in a position requiring the solution of great strategical problems, while practically every one will have tactical problems to solve.

In this study, only the General Reserve, that is the reserve at the disposal of the commander, is considered. A General Reserve is for actual use in fighting; is to be used in obtaining the supreme decision; if it is not so used it might as well be 100 miles away, except for the mental comfort of its presence.

There are two general methods of handling reserves. Some claim that a general should study the situation from all possible angles, and issue orders before the battle as to the complete operations of his reserve. Other tacticians think the general should not issue specific orders to the reserve at the beginning, but should save it for the supreme moment, and then use it as the exigencies of the battle require. The first system is more practicable for the offense, but often results in improper use of the reserve; the second system is more suitable for the defense, but often leads to no use whatever being made of the reserve. This article is for the purpose of illustrating the results obtained in actual warfare by use of the different system.

General Strategy of the Russians and Japanese

General Kuropatkin had studied the resources of the two countries in men and material before the commencement of the war. He understood that the Russians could not successfully oppose the Japanese at once and planned to fight delaying actions at every opportunity until he had received enough troops to assume the offensive. He could not adhere consistently to this plan on account of pressure from above.

The Japanese also understood that their best opportunity lay in an active offensive with a view to securing a decisive victory before the arrival of too great numbers of Russian troops from Europe.

(The writer here takes up in succession the handling of the General Reserves in the battles of the Yalu, Nan-shan, Telissu and Liao Yang. It is noted that it was the rule rather than the exception for the Russian generals to keep out their reserves, seldom using more than a relatively small fraction of their total strength, whereas the Japanese ordinarily threw their whole force into the struggle. It was this factor which usually had the deciding effect upon the result of the battles.

A table is given showing the percentage of troops not actively used by the opposing forces in a number of famous battles of other wars. Tho the circumstances governing the use of the reserves in these battles were varied by many factors, it is to be concluded that: *First,* The great generals of history habitually used the general reserves with decisive effect; and *Second,* When they failed to use the general reserves the results were generally disastrous.)

No general rule can be laid down as to the employment of the reserves. In some cases it may be well to use all the forces with a fixed object. In others, especially for defense, it will be best to retain a force that can be used in emergencies that cannot be foreseen. The timely employment of the reserve is exactly what distinguishes an able general from a timid one (who never employs it) and from a rash one (who employs it too quickly). As between these two, the latter seems preferable.

—Instruction and Training

See also

ENGINEERS—INSTRUCTION AND TRAINING (Article: "Sandbox Instruction, Etc.")

—Joint Operations—Army and Aircraft

See also

FIELD ARTILLERY—FIRE CONTROL—AERONAUTIC

"TANKS"

See

AUTOMOBILES—ARMORED

TARGET PRACTICE

See also

COAST ARTILLERY—TARGET PRACTICE

TARGET PRACTICE—Continued

—Infantry

See

INFANTRY—FIRE — INSTRUCTION AND TRAINING—TARGET PRACTICE

—Targets

[Rifle Range Target Frame—Windmill Pattern. By Lt.-Col. A. A. Crookshank, R.E. *Royal Engineers Jour.*, Nov, '17. 700 words. 1 plate.]

(This article gives the design—clearly illustrated by the plate—of a target frame on the windmill principle, *i. e.*, one target at each end of a windmill arm.)

The ordinary shutter type of sliding target is unsatisfactory for field use owing to the difficulty of obtaining suitable construction materials to enable the system to be made so as to work readily.

The advantages of the windmill type of target frame are:

1. The materials are those ordinarily obtainable.
2. The target frame supports can be used also for holding up the trench walls.
3. Jamming is almost impossible.

Of the two possible types of windmill frames, a revolving axle with attached frame or a fixed axle with frame revolving on it, the latter is preferable. The target can be more easily revolved by the marker and with less strain on the frame work; the movable portion is lighter and more easily repaired; it is also simpler to make, being devoid of metal parts. Moreover the axle can be used as a strut to take up earth pressure of the trench walls.

TELEGRAPHY

See also

WIRELESS TELEGRAPHY

—Apparatus and Equipment

[High Speed Automatic Telegraphy. By S. N. E. *Memorial de Ingenieros*, Jan, '18. 3500 words. Illustrations.]

It is believed that the Creed telegraph system, recently installed in Madrid, represents the latest developments in telegraphy. It is evident that all the obvious advantages of machinery over hand labor will apply in telegraphy, with the added fact that with the consequent decrease in the cost of sending messages we will be able to send more complete messages, avoiding the necessity for too great brevity in their wording. The Morse system has been of great value, but it is not sufficient, due to its limited speed of transmission. To remedy this defect, inventors have produced the multiple systems permitting the use of one wire by two or four operators at once, and the systems of Hughes, Baudot and Wheatstone, which increase considerably the speed of sending.

This last, as is known, is merely a development of the Morse system, replacing hand labor by mechanical. For this it is first necessary to prepare a ribbon bearing three rows of perforations along its length. The outer rows represent Morse symbols, the inner row being merely to facilitate the movement of the belt. In the outer rows, two perforations directly opposite correspond to a dot, while two, one of each row, separated by an interval, represent a dash. This belt is passed thru a transmittor which reaches a speed of 100 to 125 words per minute (five times that of the Morse). The currents in the line are the same as in the Morse system; the receiving apparatus writes the message on a ribbon in Morse code which must then be translated. To perforate the ribbon in the sending station requires four operators, and the same for the receiving station, since each can handle only about 25 words per minute. The complete system, therefore, requires eight men, in addition to one man to handle the apparatus.

The improvements introduced by Creed and Bille are as follows: 1st, a keyboard perforator to prepare the ribbon at a rate of 70 words per minute; 2d, a receiving perforator which can work up to 200 words per minute; 3d, a printing apparatus which takes the perforated ribbon and translates it into the ordinary alphabet at a rate of 100 to 120 words per minute. The transmitter is the same as in the Wheatstone, and the sending can be done in duplex as in this system. This is merely a development of the Wheatstone, and is, consequently, based on the Morse system.

The perforator is arranged with a keyboard similar to an ordinary typewriter, and is operated in a similar manner, compressed air supplying the motive power for cutting the ribbon by punches corresponding to the proper letters and also for moving the ribbon thru the proper spacing, very much as the carriage of an ordinary typewriter is moved by its spring. No very great skill is required for the operators of these machines.

The receiving perforator will reproduce at a rate of 200 words per minute the perforated ribbon so prepared. For its operation it is necessary: 1st, to operate the punches at the rate determined by the transmittor; 2d, to move the ribbon at the rate so determined; 3d, to stop the receiving ribbon momentarily as it is being perforated and then to move it quickly to catch up to its proper spacing. The Creed system uses compressed air for motive power, the Bille works solely by electrical power.

In the Creed system, the receiver utilizes small electromagnets to regulate the movement of a small reciprocating piston, by the operation of its valves. This piston in turn operates the valves of a slightly larger piston, both driven by compressed air, which moves the punches and operates the timing device for the stopping of the ribbon. This ribbon is perforated down the center before use. A small wheel with teeth which fit into these perforations in the ribbon is revolved by the movement of the ribbon. On the same axle with this wheel is a small cogwheel. A small wedge is moved into the cogs to stop the movement of the ribbon. The operation of the punches is coordinated with this action so that the punches will not cut the ribbon in slits. When the alterations in current follow quickly, as for a dot, the perforations in the ribbon will be directly opposite one another, but if they are separated by an interval of time, as for a dash, the corresponding perforations will be separated by a similar interval along the length of the ribbon.

The printing apparatus is also operated by compressed air. The ribbon which is to bear the message in the ordinary alphabet is passed below an inked

ribbon, thru which the letters are made to strike it. The movement of these letters is regulated by plungers which are connected to each letter. The movement of the plungers is regulated by means of a number of perforated plates, each of which can occupy two positions, giving a sufficient number of combinations to provide for all the letters of the alphabet. The proper plunger is able to move down when there is an opening left below it by the movement of the plates to bring together the proper perforations. These perforated plates are moved by means of a rack and pinion transmitting the movement from a number of needles which pass thru the perforations in the ribbon, the combination of needles corresponding to the Morse code causing the plates to move so as to print the desired letters.

A system organized with this apparatus should consist of one receiver (200 words per minute), three perforators (70 words each per minute), and two transmitters (100 words each per minute), necessitating a total force of eight operators. With this the system can handle more than twice the work of nine operators with the old Wheatstone system.

TOPOGRAPHY, Military

See also

ENGINEERS—INSTRUCTION AND TRAINING (Article: "Sandbox Instruction, Etc.")

TORPEDOES

—Naval

[The Action of the Torpedo at the Target. *Schweiz. Zeitschrift f. Art. u. Genie,* Dec, '17. 550 words.]

According to an article in "Prometheus" the action of the torpedo at the target is manifested by the thrusting effect of the water and the pressure effect of the gases. The former, which depends on the rapidity of detonation and the mass of the gases, has the greater destructive effect. The pressure effect depends on the energy stored in the explosive, and density of the latter, and the mass of the gases. The shock-wave travels in the water with a velocity of 7000 m/sec. The water, which is only slightly compressible, acts like a solid body. No ship's side is strong enough to withstand the blow. The pressure effect, which at a distance of one meter arrives about .04 sec. later, drives the water into the hole with great force.

Violent and rapid ignition of the explosive is aided by compression of the latter, tho if the compression is too great the rapidity of detonation is diminished. The nearer the explosion to the ship's wall, the greater the effect. 100 kg. gun-cotton at a distance of 0 cm. produce a blow of 8900 kg. per sq. cm.; at 1 m. it is reduced to 426 kg. The pressure effect is reduced in about the same proportion—1801 kg. per sq. cm. at 0 cm. distance, and 85 kg. at 1 m.

TRAILERS

See

MOTOR TRANSPORT—TRAILERS IN

TRAINING CAMPS

[The National Army Cantonments. ***Scientific American,*** Dec 1, '17. 2000 words.]

The following list of quantities shows the enormous magnitude of the undertaking of building the sixteen National Army Cantonments in a period of ninety days:

Total Material for the Sixteen Camps

Average number of cars of lumber per camp	2029
Average number of cars of other materials per camp	1948
Average number of cars handled per day at each camp	60
Total amount of wire screening	15,000,000 sq. ft.
Total amount of roofing	325 cars
Total number of doors	285,000
Total number of sashes	976,000
Total amount of wall board	31,733,000 sq. ft.
Amount plumbing fixtures per camp	$300,000
Miles of road per camp	25
Miles of railroad sidings per camp	6
Greatest number of men employed on any camp at any one time	14,000
Average number of men employed per day per camp when running peak	9,000
Highest weekly payroll	$400,000
Average payroll per week of labor	$300,000
Average number of men in official organization of Government at each camp	200

TRAJECTORY

See also

BALLISTICS

TRANSPORTATION

See

SUPPLY AND TRANSPORT

"TRENCH FOOT"

[Trench Foot. By a Military Observer. *Military Surgeon,* Nov, '17. 5500 words]

In the early development of trench warfare the armies operating in northern France suffered severely from trench foot. It was soon learned that there was a direct connection between trench foot and exposure to damp cold. As a matter of fact, the condition is really one of frost bite; the liability to this is increased by the pressure of boots and puttees. The trouble was found to be caused by standing in cold water; efforts were made to drain the trenches and to provide them with "duck boards" placed above the bottom of the trench. Practically all trenches are now provided with these improvements.

It was discovered, however, that other preventive measures were necessary. After experimenting with waterproof shoes, oiling the feet, oiled silk socks, and other steps, hip boots of rubber were found to be by far the most satisfactory means of preventing trench foot. At present all British soldiers going into the trenches for a tour of duty are supplied with rubber boots. These boots are turned over to the relieving troops.

The men are carefully instructed as to the care of their feet, and are required to carry an extra pair of dry socks into the trenches with them. Dry socks are

"TRENCH FOOT"—Continued

also sent to the men in the trenches, in waterproof packages, with the daily supply of food and water. Whale oil has been found effective if applied to the feet before entering the trenches, as it reduces the loss of heat from the feet by one-half.

The appearance of trench foot is now treated as a punishable offense, and is considered a reflection on the officers in command.

(The writer cites instances where the occurrence of trench foot has very seriously interfered with the efficiency of commands. He then discusses the pathology and treatment of the condition.)

TRENCHES

See

ENTRENCHMENTS

TRENCH MORTARS

See

FIELD ARTILLERY—MATERIEL—TRENCH MORTARS

TUBERCULOSIS

[Auscultation of Pulmonary Apices in Young Men. By Lt. J. T. King, M.R.C., U.S.A. *Military Surgeon,* Jan, '18. 2600 words.]

An examination of over twenty thousand men for tuberculosis has recently been completed at Chickamauga Park. In such work on a large scale the essential object is the discovery of the largest number of tuberculous men in the shortest possible time. Laboratory methods are, of necessity, subordinated to those of physical diagnosis. It soon became clear that soldiers presented a problem in physical examination which had not previously been fully appreciated. A large number of healthy men showed certain crackling sounds during auscultation which so closely simulated râles that their identification became extremely difficult. During the latter part of the work the writer kept notes of the men he examined with observations of the various confusing factors which arose.

In the examination of 819 soldiers, 33 instances of joint crepitation were noted. Such crepitations often simulate true râles, but may be made to disappear by simple expedients.

Twenty-three instances of transient apical crackles were found. Such sounds probably originate in the neck muscles.

Seventeen men (2.07 per cent) presented persistent apical adventitious sounds, which were very deceptive. They were unusually common in muscular young men, and constituted the most difficult problem in diagnosis encountered.

[Manifest Pulmonary Tuberculosis. By Col. G. E. Bushnell, M.C., U.S.A. (Ret'd). *Military Surgeon,* Apr, '18. 13,000 words. Illustrated.]

(A discussion of some of the salient points in the diagnosis of the manifest pulmonary lesion, with a view to indicate simple methods of reaching an approximate diagnosis and prognosis of the disease. "The effort has been made to simplify the subject by the omission of all but the most important points, in the hope of furnishing clues for threading the maze of signs and symptoms of the advanced cases.")

[The Treatment of Tuberculosis. By Col. G. E. Bushnell, U.S.A., Ret. *Military Surgeon,* June, '18. 8000 words.]

(The writer is opposed to the use of tuberculin in the treatment of tuberculosis. He has seen too many cases where serious harm has resulted from its use, and in any event it is thought to be most useful to those who need it the least. The greater part of the article is taken up with a discussion of the treatment based upon rest, fresh air, suitable exercise and proper food. The writer believes that the psychical side of treatment for tuberculosis is too often neglected, altho some of the most notable successes are attained thru it. "The physician with faith and zeal will endeavor to bring the patient's will to assume command. He will encourage optimism and perseverance, a resolute putting away of doubts and fears, a stout-hearted determination to endure cheerfully a monotonous existence. The writer's experience leads him to believe that fully two-thirds of the patients can be successfully influenced psychically.")

TUNNELS AND TUNNELING

[Tunnels and Galleries. Translated from *La France Militaire* by Col. W. R. Livermore. *Professional Memoirs,* May-June, '18. 900 words.]

The November advance of the French troops on the left bank of the Meuse and especially in the region of the Mort Homme put them in possession of numerous works constructed by the Germans. One of the works which impressed the soldiers the most was the excavation of the tunnels of Gallwitz and of the Crown Prince. Each of these attains the length of one kilometer and provides for a debouch on the southern side of the Mort Homme without crossing the summit, which was constantly swept by the fire of the French artillery. These tunnels are 2.2 to 2.3 m. in width at the bottom, 2 m. wide at the top and 2 m. high. They are heavily timbered. Numerous cells, dug perpendicular to the gallery and fitted with cots, furnished shelter for the garrison. Toward the center of the gallery, large chambers contain a complete power plant, which not only furnished light for the entire underground system but also power for enlarging the works. There are all the accessories of a barrack, with kitchens, shower baths, toilets, and most luxurious quarters for the officers, furnished with plunder from the surrounding country.

Many of the French troops who had not been in the sections of the line where the French had constructed similar works thought and said that the Germans did these things the better. This is not correct, however. Such works have existed for a long time in the Argonne and Champagne especially. They yield precedence in no respect to the constructions of the Germans.

TURKEY

—History

See also

BALKAN WARS

EUROPEAN WAR

TURRETS, Armored

See

FORTIFICATIONS—PERMANENT—ARMORED TURRETS

UNIFORMS

[Field Equipment for France. By David E. Wheeler, Reading War Hospital, Berks, England. *Jour. Military Service Inst., U. S.*, Sept-Oct, '17. 2500 words.]

On the western front there is a great deal of warm snow and cold rain—both very wet. Fuel is scarce and a real fire unobtainable, so that opportunities to dry off are few and far between. For body protection it is necessary to have an outer layer of wind and water proof material and an inner layer of soft non-conducting tissue. Woolen overcoats and heavy uniforms have very little warmth for their weight even when dry, and easily soak up water and become unbearably heavy. The same is true of sheepskin.

Light uniforms and thick underclothes are recommended. The tunic should be of waterproofed canvas the coat widely double breasted with a hood which can be buttoned to the collar. The tunic should be made short-skirted. Trousers should be made of the same material with a double layer over the front of the thighs. The Esquimaux trouser has the most comfortable pattern, is short-seated and buttonless. Instead of a waistband it is provided with a drawstring. Whatever the style, the knees should be very baggy.

Next to the skin a suit of the lightest gauze underwear should be worn, a change of this underclothing being carried in the pack. Between the suit of gauze and the waterproof uniform can be worn Mackinaw shirts, sweaters and heavy woolens to suit the taste of the wearer and the weather. Knit gloves or mittens with waterproof covers are excellent.

A man's hat, whatever its pattern, should be as inconspicuous as possible. The English pattern steel helmet has proved very satisfactory and, for a change, the broad-brimmed felt hat is desirable.

A leather gaiter condenses moisture on its inner surface and even on short marches becomes wringing wet. Before the French adopted puttees they were practically free from "trench feet," but now suffer almost as much as do their Allies. It is fairly obvious that a tight bandage reaching from ankle to knee must cause engorgement of the veins of the feet and a long series of evil conditions result.

In summer the habit of marching without socks is recommended. French roads are hard, dry and very hot. To wear woolen socks under such circumstances is sure to soften the skin of the feet, causing them to blister more easily and making them less able to stand exposure the following winter. The best way to start in is to use at first plenty of grease and one pair of seamless lisle thread cotton socks; silk is better but more expensive. By the time a pair of these socks is worn to nothing the skin of the feet is tough enough to do without them.

The U. S. A. shoe is probably the best that can be provided. For winter wear larger shoes are essential in order that two pairs of heavy knit wool socks may be worn when on duty.

The soldier should be trained and equipped for raw, wet weather, scanty fires and close range fighting. This means waterproof uniforms and short, light carbines. Overcoats and puttees are to be avoided.

[Army and Navy Uniforms and Insignia. By Col. Dion Williams, U.S.M.C. 302 pages, 125 illustrations, 5 x 7½ in. *Frederick A. Stokes Company,* New York City.]

The purpose of this volume is well stated in its subtitle, "How to Know Rank, Corps and Service in the Military and Naval Forces of the United States and Foreign Countries." About three-fourths of the book is devoted to matters relating to the various services of the United States. There is a general discussion of organization, the different branches and corps, and the gradations of rank. Detailed consideration is given to the uniforms and insignia of the United States Army, Navy, Marine Corps, Coast Guard, Lighthouse Service and Public Health Service. The various United States medals, badges and ribbons are described and illustrated, the ribbons being shown in colors.

Some seventy pages are devoted to a description of the service uniforms and insignia, for both officers and enlisted men, of the armies and navies of Great Britain, France, Italy, Belgium, Japan, Russia, Germany and Austria-Hungary. The ensigns, flags and colors of these countries are described and illustrated in colors, as are the various aircraft marks. There are interesting and instructive chapters on the "Origin and History of Uniforms" and "Honors and Distinctions."

Colonel Williams' work appears to fulfil its purpose admirably. Its appearance at the present juncture is particularly timely, with the recently aroused general interest in our own services, and the presence in our midst of so many officers and men of our allies. The value of the book is greatly enhanced by the numerous excellent illustrations which accompany and amplify the descriptions, and by the index which completes the volume.

—Footwear

See also

SHOES AND BOOTS

—Headwear

See also

HELMETS

—Insignia

See also

UNIFORMS (Article: "Army and Navy Uniforms and Insignia")

UNITED STATES

—Aeronautics

See

AERONAUTICS—INSTRUCTION AND TRAINING—UNITED STATES
AERONAUTICS—MATERIEL—UNITED STATES
AERONAUTICS—ORGANIZATION AND ADMINISTRATION (Article: "Air Power—Organization of Flying Troops")
AERONAUTICS—UNITED STATES

—Army

See also

EUROPEAN WAR—FORCES ENGAGED—UNITED STATES
RECRUITING—EXAMINATION AND STANDARDS—UNITED STATES
SANITARY SERVICF—DENTAL PERSONNEL AND SERVICE—UNITED STATES

[Annual Report of the Secretary of War. *Army & Navy Jour.*, Dec 15, '17. 3420 words.]

The annual report of the Secretary of War for 1917 bears date of Nov 20 and instead of specifying that it is for the fiscal year states it is a "report of operations of this Department for the past year." Mr. Baker begins his report with a review of conditions along the Mexican border at the time of his last annual report and draws the moral from it that: "The Mexican incident was valuable to the United States in two important ways. In the first place, it demonstrated very definitely the determination of the Government not to allow a menace to continue on our frontier; and, in the second place, by the mobilization of the Regular Army and the National Guard it gave an excellent opportunity for training both to the men in the Guard and to the several supply departments of the Government, and thus afforded a most serviceable foundation upon which to proceed with the larger expansion of the military establishment which we were soon called upon to undertake."

Our Entry Into the War

"Upon our entering into a state of war with Germany," Secretary Baker says, "Congress began the consideration of the measures necessary for the enlargement of the military forces and the co-ordination of the industrial strength of the Nation. It was understood at the outset that war under modern conditions involved not only larger armies than the United States had ever assembled, but also more far-reaching modifications of our ordinary industrial processes and wider departures from the peace-time activities of the people." Secretary Baker then traces "the enlargement of the Army" subsequent to the passage of the Act of May 18, 1917, for the temporary increase of the Military Establishment, the drafting of the National Guard, and the establishment of the sixteen divisional camps for its mobilization and training.

Of the Selective Service Law, Mr. Baker says. Our military legislation was drafted after very earnest consideration, to accomplish the following objects: (1) To provide in successive bodies adequate numbers of men to be trained and used as combatant forces. (2) To select for these armies men of suitable age and strength. (3) To distribute the burden of the military defense of the Nation in the most equitable and democratic manner, and to that end to recognize the universality of the obligation of service. (4) To reserve to the public authorities power so to control the selection of soldiers as to prevent the absorption of men indispensable to agriculture and industry, and to prevent the loss of national strength involved by the acceptance into military service of men whose greatest usefulness is in scientific pursuits or in production. (5) To select, so far as may be, these men for military service whose family and domestic obligations could best bear their separation from home and dependents, and thus to cause the least possible distress among the families of the Nation which are dependent upon the daily earnings of husbands and fathers for their support. These considerations, shortly stated, amount to a policy which, recognizing the life of the Nation as a whole, and assuming both the obligation and the willingness of the citizen to give the maximum of service, institutes a national process for the expression of our military, industrial and financial strength, all at their highest, and with the least waste, loss and distress."

Mr. Baker devotes six pages to his review of the operation of the Selective Service Law, "the success of which," he says, "is of course primarily due to the painstaking forethought and the statesmanlike breadth of view with which the Provost Marshal General and his associates organized the machinery for its execution." The total cost of the draft could not be estimated by the time the report was closed, "but, based upon the data at hand, the total registration and selection of the first 687,000 men has amounted to an approximate expenditure of $5,600,000, or about $8.11 unit cost."

The Training of Officers

With this increase of the Army came the need of more officers and of the work of the training camps. Secretary Baker says: "It would be a national loss for me to fail to record in this place a just estimate of the value to the Nation of these training camps for officers. They disclosed an unsuspected source of military strength. Nobody will suppose that, with the growing intricacy of military science and the industrial arts related to it, a country can dispense with trained professional soldiers. The fundamentals of military discipline remain substantially unchanged and, in order that we may assemble rapidly and effectively adequate military forces, there must always be in the country a body of men to whom the life of a soldier is a career and who have acquired from their youth those qualities which have, from the beginning, distinguished the graduates of the Military Academy at West Point: the disciplined honor, the unfaltering courage, the comprehension of sacrifice, and that knowing obedience which proceeds from constant demonstrations of the fact that effective co-operation in war requires instant compliance with the command of authority, the sort of obedience which knows that a battlefield is no place for a parliament. Added to

these mental and moral qualities, the body of professional soldiers must devote themselves unremittingly to the development of the arts of war, and when the emergency arises must be familiar with the uses of science and the applications of industry in military enterprise. But these training camps have taught us that, given this relatively small body of professional soldiers, the Nation has at hand an apparently inexhaustible body of splendid material which can be rapidly made to supplement the professional soldier."

Of the reasons that were taken into consideration for the establishment of the new series of training camps, Mr. Baker points out the peace-time policy of promotion by seniority "is obviously not adapted to a great military establishment in time of war." From other considerations, therefore, "the Department has established a system of divisional promotion. Such a system does not, however, integrate perfectly with the preparation of officers in training camps for which the membership is selected from civil life. A third series of training camps has, therefore, been announced to begin in January, 1918, to be held at the divisional camps of the Army and to be attended by men for the most part selected from the ranks of the enlisted men in the division. By this process the training camps will start with men who have had the elements of military discipline in the ranks. The candidates will, moreover, have been chosen by the practical tests of actually observed experience rather than on the basis of theoretical qualifications, and the whole Army will be stimulated by the opportunity thus afforded to men in the ranks to qualify for commissions by fidelity, intelligence and zeal in their ordinary occupation as soldiers. Succeeding officers' training camps will in all likelihood follow in the main the plan laid down for the third series, with such modifications as may seem wise from time to time to bring into training some part of the large body of men yet remaining in the country who have had military experience but who for one reason or another could not be received in the first two series of camps."

The Camps and Cantonments

Thirteen pages of the report are devoted to the matter of providing the thirty-two cantonments and camps for the National Army and National Guard. Familiar as we have been with the statistics of the materials used in these military cantonments they make remarkable reading when reassembled here by Mr. Baker. In the National Army cantonments alone some of the individual objects used and their quantities were: Doors, 140,000; shower heads, 40,000; heating boilers, 1800; cannon stoves, 20,000; room heaters, 20,000; kitchen stoves and ranges, 10,000; fire engines, 90; hose carts, 600; fire pails, 163,000; cots, 721,000.

The Airman and the Engineer

On the subject of aviation Mr. Baker says: "Prior to the outbreak of the European war military experiments in the air service were tentative and small. Our own experience on the Mexican border showed the art of flying in its infancy. At that time we had not in this country an adequate supply of airplanes for reconnaissance purposes upon a very limited scale, nor were our manufacturers equipped to turn out rapidly reliable scouting machines. Under the conditions of warfare on the Western front in Europe supremacy in the air entails supremacy on the land. Realizing this, the Council of National Defense, on May 16, 1917, established the Aircraft Production Board, which immediately worked out a special air program, and on July 24 Congress made the necessary provision for its execution by the passage of a special measure authorizing great expenditures and the creation of a special personnel. Prior to 1916 the largest sum expended for Army aviation was $300,000. In the latter year, however, a special urgent deficiency appropriation of $500,000 was made, and in the year 1917 appropriations aggregating substantially $700,000,000 were made for the development of the Army's air war activities." He adds that the report of the Chief Signal Officer of the Army "is necessarily reserved in its discussion of details" and alludes in general terms to the work of the civilians who have developed the flying machine, etc., that will be used by the Aviation Section.

In view of the prominence in active military operations of the Engineer Department brought about by the entrance of the country into war, Secretary Baker reviews the suggestion made in his last report for "a school for Army engineers which would keep constantly engaged upon research and as constantly engaged in devising modes and appliances for the application of scientific discoveries in military matters, since," he says, "the experience of this war emphasizes the suggestion that 'the engineer is the bridge over which discoveries of science pass into the practical uses of everyday life.'" He adds: "The Engineer School has, however, already a fair start and by relatively small appropriations it could be expanded into a great scientific agency, valuable to the country in times of peace and of the highest value under the stress of war. I beg leave, however, to urge that when Congress does address itself to this problem its plans be conceived in a broad and generous spirit. The education system of the Army, beginning with the Military Academy at West Point and followed thru the Service School and the War College, should be rounded up by the construction of a scientific institution with laboratory facilities and experimental resources to which the Regular Army officers could have recourse for the final training of their special talents."

Universal Training Not Sought

That Mr. Baker has not changed his views as to the immediate need for the establishment of a system of universal military training is shown by these words: "The subject of universal military training continues to be discussed in the country. The department has not sought and does not now seek legislation on the subject, chiefly for the reason that the formulation of a permanent military policy will inevitably

UNITED STATES—Continued

be affected by the arrangements consequent upon the termination of the present war. Civilized men must hope that the future has in store a relief from the burden of armament and the destruction and waste of war. However vain the hope may appear in the midst of the most devastating and destructive war in the history of the race, it persists—perhaps because we are encouraged by the analogous substitution of courts for force in the settlement of private controversies; perhaps because all the perfections of nature teach us that they are the product of processes which have eliminated waste and substituted constructive for destructive principles. When a permanent military policy, therefore, comes to be adopted, it will doubtless be conceived in a spirit which will be adequate to preserve against any possible attack those vital principles of liberty upon which democratic institutions are based, and yet be so restrained as in no event to foster the growth of mere militarist amibitions or to excite the apprehension of nations with whom it is our first desire to live in harmonious and just accord."

Supplies and Munitions

From the report of the Quartermaster General of the Army, Mr. Baker selects a few statistics to show the enormous burden that has been added to the peace tasks of the Q.M.C. by our entrance into the war. "The great appropriations made by Congress tell the story from the financial point of view," he says. "In 1917 the normal appropriation for the Quartermaster Corps was $186,305,000. The emergency appropriation for this department for the year 1918 was $3,000,000,000, a sum greater than the normal annual appropriation for the entire expenses of the Federal Government on all accounts. Another illustration can be drawn from the mere numbers of some familiar articles. Thus of shoes more than 20,000,000 pairs have already been purchased and are in process of delivery; of blankets, 17,000,000; of flannel shirting, more than 33,000,000 yards; of melton cloth, more than 50,000,000 yards, of various kinds of duck for shelter tents and other necessary uses, more than 125,000,000 yards; and other staple and useful articles of Army equipment have been needed in proportion." And he adds: "The problems of supply are not yet solved; but they are in the course of solution. Sound beginnings have been made and as the military effort of the country grows the arrangements perfected and organizations created will expand to meet it."

Of General Crozier's department, Mr. Baker says: "On July 1, 1916, there was a total of ninety-six officers in the Ordnance Department. The commissioned strength of this department increased substantially 2700 per cent, and is still expanding. The appropriations for ordnance in 1917 were $89,697,000; for 1918, in view of the war emergency, the appropriations for that department aggregate $3,209,000,000. This division of the War Department has had, in some respects, the most difficult of the problems presented by the transition from peace to war. Like the department of the Quartermaster General, the Ordnance Department has had to deal with various increases of supply, increases far exceeding the organization and available capacity of the country for production. The products needed take longer to produce; for the most part they involved intricate machinery and highly refined processes of manufacture. In addition to this the industrial agencies of the country have been devoting a large part of their capacity to foreign production which, in the new circumstances, it is unwise to interrupt. The report of the Chief of Ordnance sets forth as far as is prudent at this time the activities of his department. I refer to them here chiefly for the purpose of directing attention again to the valuable service rendered to the Government not only by the trained personnel of the Regular Army, which has devoted itself with unflagging energy to the preparation of the Nation to meet the emergency, but also of the civilians who have grouped themselves around the Ordance Department and brought to it the indispensable experience which they had gained in private industrial pursuits."

Mr. Baker discusses briefly the work of the Council of National Defense, the visiting war missions, the Medical Department, Insular Affairs, and gives four pages to a review of the progress of the European war. The only figures he gives of enlistments is the statement that "the total number of enlistments in the Regular Army for the fiscal year 1917 is 160,-084," the figures for the National Guard not having been completely compiled.

The Expeditionary Forces

Of the American Expeditionary Forces the report states: "As a result of the exchanges of views which took place between the military missions to the United States and our own Government it was determined to begin at once the dispatch of an expeditionary force of the American Army to France. This has been done. Gen. John J. Pershing was selected as commander-in-chief and with his staff departed for France, to be followed shortly by the full division, consisting entirely of Regular Army troops. Immediately thereafter there was formed the so-called Rainbow Division, made up of National Guard units of many States scattered widely thruout the country. The purpose of its organization was to distribute the honor of early participation in the war over a wide area and thus to satisfy in some part the eagerness of these State forces to be permitted to serve in Europe. The Marines, with their fine traditions and honorable history, were likewise recognized, and regiments of Marines were added to the first forces dispatchd. It would, of course, be unwise to attempt any enumeration of the forces at this time overseas, but the Army and the country would not have me do less than express their admiration and appreciation of the splendid cooperation of the Navy, by means of which these expeditionary forces have been safely transported and have been enabled to traverse without loss the so-called danger zones infested by the stealthy and destructive submarine navy of the enemy. The organiza-

tion and dispatch of the Expeditionary Force required the preparation of an elaborate transport system, involving not only the procurement of ships and their refitting for service as troop and cargo transports, but also extensive organizations of terminal facilities both in this country and France; and in order to surround the Expeditionary Force with every safeguard, a large surplus of supplies of every kind were immediately placed at their disposal in France.

"This placed an added burden upon the supply divisions of the Department and explains in part some of the shortages, notably those of clothing, which have temporarily embarrassed mobilization of troops at home, embarrassments now happily passed. In the organization of this transport the constant and helpful co-operation of the Shipping Board, the railroads, and those in control of warehousing, wharfing, lighterage, and other terminal facilities has been invaluable. Our activities in this regard have resulted in the transporting of an army to France fully equipped, with adequate reserves of equipment and subsistence, and with those large quantities of transportation appliances, motor vehicles, railroad construction supplies, and animals, all of which are necessary for the maintenance and effective operations of the force.

"The act authorizing the temporary increase of the Military Establishment empowered the Department to create special organizations of technical troops. Under this provision railroad and stevedore regiments have been formed and special organizations of repair men and mechanics, some of which have proceeded to France and rendered service back of the British and French line in anticipation of and training of their later service with the American Army. No complete descriptions of these activities can be permitted at this time, but the purpose of the Department has been to provide from the first for the maintenance of our own military operations without adding to the burdens already borne by the British and French, and to render, incidentally, such assistance to the British and French armies as could be rendered by technical troops in training in the theater of operations. By this means the United States has already rendered service of great value to the common cause, these technical troops having actually carried on operations for which they are designed in effective co-operation with the British and French armies behind the hotly contested battle fronts."

—Army—Artillery

See

ARTILLERY—UNITED STATES
FIELD ARTILLERY—MATERIEL—UNITED STATES
FIELD ARTILLERY—TRANSPORT—BY MOTOR
FIELD ARTILLERY—HEAVY—INSTRUCTION AND TRAINING—UNITED STATES

—Army—Cavalry

See

CAVALRY—ORGANIZATION—UNITED STATES

—Army—Engineers

See also

ENGINEERS—UNITED STATES
UNITED STATES—COAST DEFENSE (Article: "Annual Report, Chief of Engineers")

—Army—Matériel

[Annual Report of the Board of Ordnance and Fortification. *Army & Navy Jour.*, Dec 15, '17. 1000 words.]

Among the projects inaugurated the construction and tests of targets representing different types of parapet and sea coast fortifications and the development of a self-propelled oil-electric, armored railway car are particularly important, the report states. The Fortification Appropriation Act approved July 6, 1916, provided $750,000 for the purchase of the rights pertaining to the Hammond radio dynamic system of torpedo control, in addition to $417,000 for procuring and installing one unit of the system. The appropriations are, however, limited by the requirement for approval of purchase by the President after a satisfactory demonstration before a board of three Army and three Navy officers. The testing board has been named and the tests are in progress. Preparations for the test of radio control of torpedoes from an airplane in flight under the Hammond system are practically completed.

An experimental emplacement was constructed at Fort Morgan, Ala., and a gun and disappearing carriage erected therein to determine the effect of hostile fire on men and matériel. The Navy Department assisted by having ships fire at the emplacement with their heaviest guns at various ranges. The tests were successfully carried out in March, 1916, and useful information was obtained. Work on the construction of experimental targets is now in progress at Sandy Hook, representing five different types of parapet for sea coast fortifications, in order to test the effect of fire thereon, from 12-inch and 14-inch guns at ranges corresponding to those which may be expected in a long range bombardment by a hostile fleet. Work on the construction of a railway car propelled by a 200-horsepower oil engine with electric drive, fitted with an armored cab, searchlight and conning tower, and carrying a normal armament of two machine guns, is now in progress. The development of a portable searchlight for use in field artillery was completed and turned over to the Field Artillery board for tests. A test of an apparatus by means of which photographs taken in the field could be enlarged for the immediate use of commanders or projected on screens demonstrated that the apparatus does not possess sufficient merit to warrant its adoption. Encouraging tests of submarine mines containing the Leon device for automatically controlling the depth of submergence have been held. The advisability of procuring and testing at the Government expense a number of sights of the new design developed by Mr. R. L. Warner is now under consideration.

As a result of tests of searchlights and star bombs and flares, a type of trench searchlight has been

UNITED STATES—Continued

adopted for issue to the Service. Of the illuminating bombs procured the conclusion was reached that the adoption of a standard type of flare was not necessary, it being a simple device readily obtainable in suitable form. As a result of the tests of motors for ponton boats the outboard motor of the type represented by the Evinrude was approved for use with ponton boats. The Jeffrey truck intended for use in the development of portable searchlights is now being tested under service conditions. Work on the designs for a type of turntable mount for use with siege artillery and preparations for the test are now in progress. A test made of the Solano targets purchased abroad, which took place at the School of Musketry, proved that they were well suited to the purpose for which intended. The question of their adoption is under consideration.

Designs for a portable radio set are in progress, and work for the development of types of navigating instruments for use in airplanes is being carried on by the Chief of the Signal Corps. The work of developing cameras for use in photographing from aircraft is still in progress. An armored car designed to mount a 3-inch gun in the center, which has brackets and ports for a number of machine guns in addition, has been completed and tested to be turned over to the Engineer Department for use in the Service. Several types of illuminated compasses have been procured and are undergoing tests, and orders have been placed for other types. The construction and test of a railroad flat car mounting a 7-inch howitzer have been completed and it has been delivered. The work on the mount is in progress.

Tests of detonating trinitrotoluol have been completed at Sandy Hook Proving Ground, and the report thereon is in course of preparation. Several submarine detectors of different types have been constructed and tested with surface power vessels, but no conclusion can be reached as to their usefulness in accomplishing the purpose for which they were designed until the use of a submarine boat can be made available by the Navy Department. The board has submitted an estimate for $150,000 to carry on its work for the fiscal year ending June 30, 1919, and it is recommended that the appropriation be made as heretofore in a single amount.

—Army—Officers

[Tests for Our General Officers. *Army & Navy Jour.*, Dec 15, '17. 200 words.]

All general officers of the Regular Army and the National Guard are being examined by medical boards and efficiency boards with the view of determining the advisability of sending them for service abroad. The conditions of foreign service in this war are unusually severe, requiring that general officers shall be not only adequately grounded in military science and adequately alert physically to acquire rapidly the lessons which the new form of warfare, require, but able to endure prolonged hardships.

—Army—Organization

[Development Battalions Instituted. *Army & Navy Jour.*, June 22, '18. Quoted.]

Development battalions that were authorized by the War Department under G. O. No. 45 have been instituted at each of the depot brigade and replacement camps and are already showing excellent results in the number of men that have been rendered fit for duty. As we previously noted these development battalions are for the purpose of conducting intensive training with a view to the development of unfit men for duty with combatant or non-combatant forces either here or abroad and to promptly rid the Service of all men who after thoro trial and examination are found physically, mentally or morally incapable of performing the duties of a soldier. The complete report required of the officers in charge will be of great assistance in working out the problem of dealing with the temporarily or permanently unfit men who have entered the Service.

[Growth of American Army in One Year . . . *Official Bulletin*, July 5, '18. Quoted in part.]

The Secretary of War has made public the following information:

"1. Since Apr 6, 1917, the Regular Army has increased from 5791 officers and 121,797 enlisted men to 11,365 officers and 514,376 enlisted men; the National Guard in Federal service, from 3733 officers and 76,713 enlisted men to 17,070 officers and 417,441 enlisted men; the Reserve Corps in actual service has increased from 4000 enlisted men to 131,968 officers and 78,560 enlisted men; the National Army has been created, with an enlisted force of approximately 1,000,000 men.

The army has increased in 14 months from 9524 officers and 202,510 enlisted men to approximately 160,400 officers and 2,010,000 enlisted men.

The number of men in France or en route to France, including combatants, medical service, service for supply, and all the units which go to make up an entire army is on July 1 practically 1,000,000 men.

2. Supplies for soldiers: The size of this undertaking may best be seen by these typical purchases made by the Quartermaster Corps from the beginning of the war, to June 15, 1918:

Articles:		Quantity.
Hardware and Metals		
Hammers		2,567,000
Axes		5,121,729
Files		10,870,000
Vehicles and Harness		
Halters		1,700,000
Escort wagons		129,000
Combat wagons		26,000
Animals		
Horses and mules		339,593
Clothing and Material for Clothing		
Shoes	pairs	27,249,000
Boots, rubber, hip	do	2,340,000

Overshoes, arctic	do	4,010,000
Cotton undershirts		43,992,000
Denim cloth	yards	103,028,000
Stockings, wool	pairs	104,333,000

3. Health of men in cantonments: The deaths per thousand, from all causes, in the Regular Army of the United States has been as follows:

1898	20.14
1900	7.78
1901	6.90
1916	5.13

The death rate per thousand among all troops—Regulars, National Army, and National Guard—in the United States for the week ending May 31 was 4.89, and for the week ending June 7, 4.14. The death rate for disease only among all troops in the United States for the week ending June 7 was 3.16, which is still lower than that of the preceding week (3.2), which was then the record low rate since that of Nov 2, 1917.

Hospitals in U. S. and France

The bed capacity on June 5 in all department hospitals in the United States was 72,667. New construction now under way will provide for a total of 87,344 beds. The number of base and general hospitals in this country has increased from 7 to 72, and will be further increased. Vast hospital facilities have been organized and are being organized in France, providing beds numbering from 5 per cent to 10 per cent of the number of men in the American Expeditionary Forces.

Psychological examinations, of which more than 500,000 have been made, result in the weeding out of about one-fourth of 1 per cent of the men examined.

Nutritional surveys in 270 messes in 50 camps have resulted in a readjustment of rations and a conservation of food.

The number of officers in the Medical Corps has increased from 900 to 24,000; the number of enlisted men from 8000 to 148,000. These figures, of course, are exclusive of the Sanitary Corps and of the army nurses.

4. Transportation in France: With the completion of the organization of 5 new regiments and 19 battalions of railway engineers there will be over 45,000 Americans engaged in railroad construction and operation in France. Nine regiments of railway engineers have been in France since last August.

Railroads in France

There have been produced for the railroad operations of the War Department in France more than 22,000 standard gauge and 60 C. M. freight cars and more than 1600 standard gauge and 60 C. M. locomotives. In addition to this, purchases of both cars and locomotives have been made abroad.

A double line of railroad communication has been secured from the French by army engineers, extending from the coast of France to the battle front, including the construction of hundreds of miles of trackage for yards and the necessary sidings, switches, etc.

Production of Aircraft

5. Aircraft production (training planes, bombing planes, combat planes, and guns therefor, and production of Liberty engines):

Deliveries of elementary training planes to June 8 4,495
Deliveries of advanced training planes to June 8. 820

The average weekly production of advanced-training planes during April was 22; during May was 45½; week ending June 8 was 78.

To June 8, 286 combat planes were delivered. The weekly average of this type of machine in April was 5; in May, 38; and for the week ending June 8 was 80.

Six thousand eight hundred and eighty elementary-training engines were delivered to June 8; 2133 advanced-training engines were delivered to same date.

More than 2000 Liberty engines have now been delivered to the army and the navy. The average weekly production in April was 96; in May, 143; and in the first week of June 115.

Thirty-seven thousand two hundred and fifty machine guns were delivered for use on airplanes before June 8.

6. Rifles and ammunition: More than 1,300,000 rifles were produced in America and delivered between the declaration of war and June 1 of this year.

Deliveries of new United States model 1917, the so-called modified Enfield, have passed the million mark. In the two weeks preceding June 1 more than 66,000 rifles were delivered. Sufficient rifles are being received now to equip an army division every three days.

Guns and Ordnance Supplies

7. Ordnance supplies, artillery, Browning guns, etc.: As to machine guns, heavy Browning guns for instruction purposes are in every National Guard camp and National Army cantonment in this country where troops are in training. During May more than 900 of these heavy machine guns were delivered.

More than 1800 light Browning machine guns were delivered in May.

Probably the most difficult undertaking in the outfitting of an army is the manufacture of heavy artillery. Not only are the forging and machining processes extremely difficult, but it has been necessary to create manufacturing facilities for a vast proportion of the program. Sixteen plants had to be provided for the manufacture of mobile artillery cannon. In practically all cases these plants had to be retooled, and in some cases they were built from the ground up. The same difficulty is met in the design and manufacture of artillery carriages, but the artillery program is now approaching a point where quantity production is beginning.

The first of four government-owned shell-fitting plants has been completed and is beginning to produce. In addition, a number of private plants are at work loading shells.

Vast as were the privately owned facilities for the manufacture of powder and high explosives, the government has provided additional facilities which are very much larger than those which private enterprise had created.

Ordnance engineers, it seems, are well on the way to a solution of the problem of the motorization of field artillery. The problem of motorization of light

UNITED STATES—Continued

artillery has been a constant factor in slowing up the advance of troops to await the bringing forward of their supporting guns. Tractors have been used by all nations, of course, to haul heavy pieces along good roads, but they have been unable to develop tractors for hauling light pieces over shell-shattered ground. On June 3 the Ordnance Department demonstrated a 5-ton armored artillery tractor which proved capable of negotiating the most difficult terrain, hauling a 4.7 howitzer which weighed approximately 9000 pounds.

Approximately $90,000,000 are being spent to provide for the manufacture of nitrates, which are essential in the manufacture of explosives, but which have heretofore had to be procured from Chile. The building of these plants will add to our powder output, will save large amounts of cargo space, and it is supposed after the war will produce nitrate for fertilizing American farms.

Port Facilities in France

8. Port facilities in France: Among the most dramatic stories of the war is that of the development by American engineers and American enterprises of port facilities on the French coast. It is not permissible to say where this development has taken place, but the scope of it may be judged by the fact that it would be possible to handle during the month of July a maximum of 750,000 tons at the ports of the American Army in France.

It was necessary, before troops of the American Expeditionary Force could be landed, to send an organization of foresters into the woods of France, to send knocked-down sawmills after them, to cut down trees, to shape them into timbers, and to build them into docks in order that our troops might leave their ships. Vast as this work was and much as the flow of troops has been accelerated, the facilities for dockage have kept pace with the shipments of troops and supplies."

—Army—Ordnance—Matériel

See also

Browning machine gun

—Army—Ordnance—Stores

See

Arsenals—United States

—Army—Personnel

See also

United States—Military policy of—Compulsory military service

[Classification of Army Personnel. *Army & Navy Jour.*, May 4, '18. 800 words.]

To handle the problem of personnel and occupational qualification for the Army a committee made up of officers and men from the army and from civil life was organized and the new card index in use in every unit in the army was prepared. In order to add to the value of that card index system a "Trade Specifications and Occupational Index of Professions and Trades in the Army" has been prepared by the committee.

The purpose of the manual is to standardize vocational terminology in the army and to define the duties of specialists and skilled tradesmen required by the various technical organizations which have become necessary units in the modern army. The proper use of the manual will facilitate prompt and efficient placement of specialists and skilled men in army duties where each man's knowledge and ability will be immediately most effective and in the manual all the fundamental occupations and trades for which need in the army has arisen are listed and defined. Each definition states first the duties to be performed; second, the qualifications of a well trained high grade man or all around journeyman who can do this work; and third, the nearest equivalent or substitute occupations to be drawn upon as a source of supply, if necessary. The specifications describe the ideal skilled man from the army standpoint. It is not expected that all the stated qualifications will be found in each man, and in using the book it is suggested that the immediate and large needs of the army for specialists must be met by utilizing the substitutes stated or less skilled workers and apprentices.

Occupational, group and code indexes are given to facilitate the use of the specifications and all are keyed to the names and symbols employed by The Adjutant General's Office. If the commanding officer at any cantonment needs a number of men possessing certain qualifications he can call upon The Adjutant General's Office requesting the men and reference to the card index will at once indicate at what points or stations these men are available to respond to the call. If, for example, General Pershing wants hydraulic engineers he can cable using the code letters and precede this with the number of men required. If men can be used possessing the qualifications named in a less degree it can be specified or varied in many respects, but this must be indicated distinctly by using the instructions given in the book.

One of the greatest benefits that will accrue to the Service is the elimination of verbiage in cable and letter requisitions for specially qualified men, for each classification is complete and the varying qualifications are indicated by the use of a figure or other sign that cannot be easily misunderstood. The specifications make up what is probably the first work of its kind ever compiled, and it has been adopted in shipbuilding plants and is being used by the production branch of the Navy and in the Department of Labor as a basis for extensive publications along similar lines. Practically every occupation required in any branch of the Service is enumerated, and combined with the complete card system it is a matter of comparatively few minutes to locate any sort of man that may be needed at any place in the Service. By the use of the specifications men who are of no value in a particular unit will not be sent to that unit, and if a man is possessed of valuable technical qualifications he can be transferred without delay to the unit where he will perform service that is congenial and become of correspondingly increased value to the army. Revisions and additions to the volume will be made from time to time as changing conditions demand.

—Army—Sanitary Service

[Army Receiving Hospital. *Official Bulletin*, Nov 28, '17. 325 words.]

A site on Staten Island has been selected for a large receiving hospital for U. S. soldiers who are disabled in Europe and brought back to this country. The establishment of this hospital marks the beginning of a comprehensive plan for the reconstruction and rehabilitation of our soldiers who are disabled in the line of duty.

When received at Staten Island, the men will undergo thoro physical and mental examinations and the requirements of their individual cases will be studied. Each man will then be transferred to a general or special treatment hospital where his particular disability will be treated by specialists. During his stay in the latter hospital the soldier will be given light work to aid in his convalescence, and where necessary he will be given special training for new occupations under the direction of vocational experts. At the time of his discharge it will be the duty of the Government to assist him in returning to his proper place in industry.

[Medical Work with the American Expeditionary Forces. By Maj. Robert B. Osgood, Medical Corps, U.S.A. *The Military Surgeon*, Oct, '18. 3000 words.]

In the course of a lecture given by Maj. Robt. B. Osgood, M.C., to the officers of the Office of the Surgeon General, U. S. Army, many interesting things were noted as to the progress of the medical work with the American Expeditionary Forces. To begin, in the general medical headquarters an excellent communal and co-operative system reigns. Automobiles have been pooled, a common mess established, and all relations are of a most cordial nature.

The first real work is to be had with the pre-combat period of the troops. Only casual cases occur which need medical or surgical treatment, and they are sent to the base hospitals. The greatest work is with mental defectives and psychiatrics whose defects have developed since their enlistment into the service. Next in order of importance are the genito-urinary cases, which by the latest system are treated within the division. For developed cases six months is considered necessary. Then again, foot strain due to faulty shoes or other causes has in some cases interfered with 15% to 20% of the men of a regiment and prevented them from attending regular routine drills. This is caused by the unusually hard training these men had gone thru in too short a time, in consequence of which they have to be sent to base hospitals to rest.

At the suggestion of Col. Bevans, M.C., an experiment was made in one of the small villages where men with foot troubles would be sent, instead of to the base hospitals, and where they would be under the supervision of line officers, as well as orthopedic surgeons, and in this way keep up their military training in a modified form. So far the experiments have been encouraging.

The medical work in the combat divisions consists principally in getting the cases back to the evacuation hospitals in the shortest possible time, and in the best possible condition. Practically no surgery, except the stopping of hemorrhages, the halting of a case of shock, or an occasional chest or abdominal emergency operation is done in the field hospital or advanced dressing stations.

With the combat divisions are 3 classes of specialists—genito-urinary, psychiatry, and orthopedic surgery. Cases reaching the evacuation hospitals within 12 hours after receipt of wounds show 90% of successful closures, according to the records of our own Evacuation Hospital No. 1.

Standardization of splints was an important consideration which was investigated by a Splint Board, of which Col. W. L. Keller, M.C., was chairman. This board quickly adopted a standard splint which limited the number to be used at the front to 7. A manual giving instructions on the subject was printed, and 25,000 copies distributed at the expense of the American Red Cross.

At evacuation hospitals the surgery is of an emergency nature, and is almost entirely in the hands of generous surgeons who have absolute sway, but in exceptional cases may call specialists for consultation.

Cases which can stand removal from the evacuation hospitals are sent to either the base hospitals of the advanced zone, the special hospitals of this zone, or directly to the base hospitals of the intermediate and base zones. Of these special hospitals, some are known as "Bone and Joint" hospitals, genito-urinary hospitals and psychriatic hospitals; all in charge of specialists.

The fitting of artificial limbs has caused much inconvenience due to the delay which is frequently the case. In one country there are now over 10,000 waiting cases. This necessarily keeps the patient from a profitable occupation, and consequently dissatisfied. To prevent this delay, these cases are sent to Base Hospital No. 9, where the patients are fitted with a temporary limb and sent back to America for the fitting of a permanent artificial limb.

The curative workshops which are being established for the permanently disabled are among the most interesting features of the work. The first thing is to defeat the cripple's idea of helplessness and to awaken and foster in him a spirit of future usefulness. To do this, his mind must be taken from the war, and he must concentrate his attention on other things, chiefly those which will be of professional benefit in whatever vocation he may seek his future living. Once he is discharged from the hospital his rehabilitation must be taken care of by the civic administration or the Pension Bureau.

—Army—Schools and Training

[To Complete Army Training Abroad. *Army & Navy Jour.*, May 4, '18. 300 words.]

The War Department (U. S.) is fully prepared to handle all the additional men that may be needed to enlarge the present armies. Under the present plans it will not be necessary to construct any new cantonments, altho those now in use may be expanded. The cantonments in the future can be emptied rapidly enough to allow the quartering of new forces from the draft. This will be done by sending the troops to cantonments in France as soon as they are reasonably well organized, disciplined and trained, instead of hold-

UNITED STATES—Continued

ing them for more intensive training. The intensive training is to be done abroad, and by this scheme a continuous emptying and filling of cantonments can be carried on. As soon as there is room at a cantonment for a quota of new men from the draft they can be called for, and by this plan the formation of our additional forces can be hurried. Some organizations already have been sent abroad under their full strength because it has been found that new and practically untrained men needed to fill them up can be more readily trained after they join the organization abroad. In the company of men who have already received intensive training the new men will be fitted for the battle line much more rapidly than could be possible in training them as recruits at a home camp.

For the present Camp Gordon, Ga., is used as an Infantry replacement division. Later Camp Lee, Va., will be devoted to this purpose and there will be several replacement divisions eventually. Camp Jackson, S. C., is now rated as a Field Artillery replacement post, and men selected for services with the guns go there for training. Camp Hancock, Ga., is the machine-gun replacement post and Camp Humphreys, Va., the Engineer replacement center. Camp Meade eventually will be used for Signal Corps and liaison replacement work.

—Army—Staff

[Army General Staff Reorganized. *Official Bulletin*, Feb 11, '18. 1750 words.]

The Chief of Staff has been directed to organize the General Staff into five main divisions under his direct control and to attach to the General Staff such personnel, officers and civilians, that the work of the General Staff may proceed. Each division shall be under an officer who shall have full power to act for the Secretary of War and the Chief of Staff upon all matters charged to his division. Such divisions and duties of each are as follows:

THE EXECUTIVE DIVISION

One. Executive Division.—This division shall take charge of the office of the Chief of Staff under an officer to be known as the executive assistant to the Chief of Staff, who shall be an assistant to the Chief of Staff. The executive assistant to the Chief of Staff shall act for the Chief of Staff or the Acting Chief of Staff during their respective absences. This division shall have cognizance and control of the following subjects:

(1) To supervise the organization, administration, and method of all divisions of the General Staff and the several bureaus, corps, and other agencies of the War Department, to the end that all such matters may be comprehensively treated and the activities of all such agencies may be co-ordinated, duplication of work avoided, harmonious action secured, and all unnecessary machinery of organization and administration eliminated.

(2) The collection, compilation, and maintenance of all statistical information obtained from the several bureaus, corps, or other agencies of the military establishment, both as to troops and supplies, as well as all other statistical information obtained from outside sources relating to the war program for transmission to the Secretary of War, the Chief of Staff, the War Council, the General Staff, and the several divisions thereof.

(3) Military intelligence concerning espionage, counterespionage, fire prevention, and other matters thereto related.

(4) Requisitions and permits.

(5) Promotions and assignments.

(6) The Militia Bureau and Federal Guards.

WAR PLANS DIVISION

Two. War Plans Division.—This division shall undertake the study of and submit reports upon all matters referred to it from time to time by the Chief of Staff and shall be in charge of an officer designated as the director of the War Plans Division. This officer will be an assistant to the Chief of Staff and shall be president of the War College and in charge of all activities at the War College. The duties of this division shall also include the following matters:

(1) Plans for the organization of all branches of the army.

(2) The study and determination of the types and the quantities of equipment for all branches of the army, and the approval of design and types of equipment submitted by the several bureaus; supervision of research and invention by the several bureaus or other agencies of the military establishment in connection with equipment.

(3) Projects for national defense.

(4) Training for all branches of the Army, the tactics and methods of warfare to be employed, together with all publications having relation thereto, and the supervision of military schools.

(5) Military intelligence as related to army operations and the translation and compilation of foreign documents relating to military affairs.

(6) Collection, compilation, and maintenance of complete military records.

(7) Proposed legislation and the preparation of regulations and rules for the military establishment.

PURCHASES AND SUPPLIES

Three. Purchase and Supply Division.—This division shall have cognizance of and supervision over the purchase and production of all munitions and other supplies required for the use of the army, under an officer designated as the Director of Purchases and Supplies, who shall be an assistant to the Chief of Staff. The duties of this division shall include the following matter:

(1) The supervision and direction of all purchase, procurement, and production activities of the several bureaus, corps, and other agencies of the War Department.

The co-ordination and correlation of the purchase and procurement activities of the several bureaus, corps, and other agencies of the War Department.

The representing of the army in all arrangements for co-ordinating the purchase and procurement ac-

tivities of the several bureaus, corps, and agencies of the War Department with other agencies of the Government and with the allies.

(2) The determination of purchasing and manufacturing priorities between the several bureaus, corps, and other agencies within the War Department and in relation to other agencies of the Government, and also the determination of preference to be afforded to contractors for supplies in the matter of shortage of fuel, power, and raw materials.

(3) The supervision and co-ordination of all appropriations, estimates and requirements and other financial matters relating to the purchase of munitions and all other supplies.

(4) There shall be in the Purchase and Supply Division the office of Surveyor General of Supplies under an officer or a civilian.

It shall be the duty of the Surveyor General of Supplies to provide that all arrangements for the purchase, procurement, and production of all munitions and other supplies for the use of the army shall be so correlated and otherwise scheduled as most effectually to forward the army program and most advantageously utilize the industrial resources of the country.

STORAGE AND TRAFFIC

Four. Storage and Traffic Division.—This division shall have cognizance and control of the transportation of all branches of the army and of all munitions and other supplies for the army both by land and sea and all storage facilities in connection therewith, under an officer designated as the Director of Storage and Traffic, who shall be an assistant to the Chief of Staff. The duties of this division shall include the following matters:

(1) All movements of troops, as well as of munitions and of supplies of every kind, including raw materials and finished products both during manufacture and after assembly, to points of embarkation, interior points and overseas points, and in an out of all storage.

(2) All inland traffic, embarkation service, and overseas service relating to the army program, including the employment of all army transports engaged in the trans-Atlantic service and such commercial shipping as may be used to supplement that service, including all arrangements with the Navy Department for convoy service.

(3) All storage for munitions and all other supplies of the army on the seaboard and at interior points.

ARMY OPERATIONS

Five. Army Operations Division.—This division shall have cognizance and control of army operations under an officer who is designated as the Director of Operations, who shall be an assistant to the Chief of Staff. The duties of this division shall include the following matters:

(1) The operation of all branches of the army, the recruitment and mobilization of the army, the personnel of troops, the selection of special troops, the movements and distribution of troops, and the determination of all overseas priorities.

(2) The assignment of equipment to all branches of the army and the determination of priorities with respect to such assignments.

(3) The supervision and co-ordination of camp sites, cantonments, army posts, hospitals, sanitation, construction plans and projects as the same relate to all branches of the army.

[Planning for a History of the War. *Army & Navy Jour.*, Apr 6, '18. 350 words.]

Having in mind the importance of an accurate account of the operations of the present war, the General Staff of the U. S. Army is forming a committee for the purpose of collecting and preserving the data necessary for a history. The chief purpose of the work will be for the education of officers and as a reference book in the future. Study will be made of the strategy and tactics applied in the important battles, and comparisons will be drawn with similar battles.

—Army—Supply and Transport

See
MOTOR TRANSPORT—UNITED STATES

—Coast Defense

[Annual Report of the Chief of Coast Artillery. *Army & Navy Jour.*, Dec 22, '17. 2030 words.]

Maj.-Gen. E. M. Weaver, Chief of Coast Artillery, U.S.A., in his annual report dated Oct 15, 1917, gives a large amount of interesting data. A most reassuring statement is the following: "It may be said that the funds which Congress has appropriated for the coast defenses have been wisely expended, that we have in consequence the most formidable coast-defense armament and accessory equipment in the world. We have a personnel of sufficient size adequately to man the armament. This personnel is as highly trained and as efficient a body of artillery experts as exists in any country.

"Apart from this normal duty of the Coast Artillery Corps and the high measure of efficiency which it has in the performance of that duty, it is to be pointed out that, in times of emergency such as during the present war, when the danger of seaward attack from capital ships does not exist, the Coast Artillery Corps presents itself as a body of highly disciplined soldiers having a high value for general military purposes. This aspect of the general utility of the Coast Artillery personnel is evidenced by the fact that at the present time its officers and men are serving in every branch of service, and, were the necessity to arise, this same personnel would be able to go aboard our battleships and, after a little special instruction, serve efficiently the guns mounted in the turrets and batteries of such ships."

The main work of the Office of the Chief of Coast Artillery during the year had to do with questions involving the best utilization of the officers and men of the Coast Artillery Corps in supplementing in the most efficient manner possible the work of the expeditionary forces in France. Gen. Weaver indicated

UNITED STATES—Continued

in a number of memoranda how, in his opinion, the commissioned and enlisted personnel of the corps might best be so utilized. He pointed out that, in view of the fact that under the existing conditions the German fleet is held closely to its fortified base, it may be assumed that the coast cities would not be exposed to an attack by capital ships; that the only attack to be anticipated would be such as might be made by the small caliber guns of submarines or stray raiders. Under this assumption, it was pointed out that the personnel assigned as the manning body of the major caliber guns might well be considered available for service in France in manning railway artillery, heavy tractor artillery, trench mortars, and anti-aircraft guns. It was pointed out further that it would be possible, without incurring any undue risk, to dismount a number of the major and intermediate guns of the coast fortifications and mount them on railway mounts or heavy motor truck mounts for use in France.

These views of the Chief of Coast Artillery were approved by the General Staff and as a consequence projects have been drawn up involving the use of a considerable number of officers and enlisted personnel of the Coast Artillery for service with artillery of this type in support of the expeditionary forces abroad.

The recommendations of General Weaver have also involved projects for maintaining the instruction and training of a complete manning body for the home coast defenses, with the view to being able at any time to serve the coast armament, and in addition thereto to train, in so far as practicable, a personnel capable of filling vacancies due to casualties and other causes in the Coast Artillery personnel on duty in France. The policy of the office has further contemplated that the Coast Artillery personnel of the fortifications of Panama, Hawaii, and the Philippine Islands should not be drawn upon materially in carrying out the special projects referred to above.

Efficiency of Our Artillery Fire

The tactical value of the demonstrated efficiency of our system of computing corrections before the first shot can hardly be too strongly emphasized, Gen. Weaver says. Not only will it minimize the expenditure of ammunition during registration, but it will permit effective fire to be opened upon any registered target without airplane observation—a most valuable feature for neutralization fire. In counter-battery work, and when switching, it will greatly reduce the exposure of the airplane during adjustment. It is felt that the result of years of training in the methods of correction for meteorological and ballistic variations will make the Coast Artillery an invaluable arm for the service of all types of heavy guns.

The most striking feature connected with the practices was the illustration of the ease of conversion of our heavy Coast Artillery system of fire direction to the system universally adopted abroad. The system which had been perfected after three years of warfare in Europe is practically identical to that which has been used in our Coast Artillery since 1904, with slight modifications which relate principally to meteorological corrections and the utilization of aircraft for the observation of fire. Satisfactory progress has been made in the installation of guns capable of delivering the long-range fire now demanded for defense against attacks for long-range guns carried by modern battleships. The construction of a portion of fire-control equipment of a type permitting the furnishing of the required data for these increased ranges is now under way, and deliveries have already begun.

Type of Gun Carriage

As to the question relative to the use of the disappearing type or the barbette type of seacoast gun carriages the report states that the disappearing type is mechanically sound and can be constructed to meet satisfactorily the required conditions. The disappearing principle should be retained for major-caliber guns in localities to which it is particularly adapted. No one type of mount should be adopted for major-caliber guns as applicable to all cases, but the type should depend upon the locality and the particular purpose for which the gun is mounted. To determine the possibilities of a modern barbette gun carriage for major-caliber guns, such a carriage for a 50-caliber 16-inch gun should be designed and constructed as promptly as present conditions will warrant. The 6-inch gun is essentially of the rapid fire type, and for future construction it should have a barbette or pedestal mount instead of the disappearing carriage.

In future projects for the defense of any locality consideration should be given to the use of major-caliber guns on mobile railroad mounts. Present and future developments demand that gun carriages for major-caliber seacoast guns in fixed emplacements be designed so as to permit the gun to be fired at an elevation corresponding to its maximum effective range; to permit all-round fire; to be provided with periscopic sights; and to be provided with adequate protection against intermediate caliber projectiles and attack from the air.

[Annual Report, Chief of Engineers. *Army & Navy Jour.*, Dec 8, '17. 800 words.]

The Chief of Engineers, Maj.-Gen. William Black, U.S.A., in his annual report for the fiscal year 1917 to the Secretary of War, recommends the adoption of a "regular annual program which will provide for replacing each year from four to ten per cent of our older emplacements depending upon the size and condition of the older emplacements and the rate of progress being made in naval defense." A fixed project for seacoast defense can never be adequate and its obsolescence must begin before it is completed, says the report, and adds: "Of the existing emplacements (in this country) over 90 per cent were completed or were in progress at the end of the Spanish War. When designed and constructed our seacoast batteries were thoroly modern and fully adequate for the purpose for which they were intended, but the work of battery construction has in the past few years been allowed to practically cease and has not kept pace

with the recent progress in naval development. It cannot be too emphatically stated that the art of fortification is a progressive one. . . . However carefully planned and constructed, a battery must always pertain to the date when completed and must be out of date in so far as relates to things which have been discovered or developed since the battery was planned.

"The seacoast defenses already erected at the entrances of our most important harbors are a formidable obstacle against entrance by a fleet. When these are reinforced by additional defenses planned and partly in course of construction it is believed that the use of these harbors by the enemy fleet will be forbidden and that adequate provisions will have been made against destruction by direct fleet fire of the cities bordering these harbors and of the important military objectives contained therein." But even then safety is not assured, Gen. Black warns, because under such conditions "the attack usually is made from the land by an expenditionary force . . . supplemented by attacks from the air." He continues: "Adequate preparation for defense against these attacks has not yet been made. Mobile Army forces must be available on the exposed frontier in numbers sufficient to provide for patrols along the shores, for outposts to reinforce these patrols, and for a reserve close enough to reach the threatened point before any large enemy force can be debarked and can secure its position by entrenching, and in strength great enough to repel the invader."

Urges Provision of Mobile Ordnance

Gen. Black in addition recommends that immediate steps be taken to provide "mobile artillery of all classes," including heavy guns and howitzers mounted for transit on highways and on railways, and of power sufficient to compel shipping to keep beyond range; armored trains with and without heavy ordnance must be provided for the patrol of exposed coasts bordered by railways and "equally important, anti-aircraft guns must be provided in large numbers." Comparatively little has been done along these lines, he states, altho projects for anti-aircraft guns have been adopted.

$892,000,000 for Engineers Oversea

Gen. Black's report includes estimates for 1919 aggregating $892,000,000 and the statement is made that these estimates are "based on providing and maintaining the engineering equipment for 1,500,000 men." Equipment of Engineer troops is estimated at $135,000,000. The Urgent Deficiency Act of June 15, 1917, appropriated nearly $36,000,000 for the purchase of Engineer equipment for the Expeditionary Forces, but this has all been disbursed in addition to more than $12,000,000 spent in behalf of the ten special railway regiments authorized in G.O. 108, War Dept., 1917.

At the close of the fiscal year orders had been placed and contracts let for the equipment of seventy Infantry divisions, and partial deliveries already had been made. "The day after war was declared," says the report, "the Engineer depot issued advertisements for the procurement of equipment for approximately 1,000,000 men; within 350 hours after war had been declared the depot had made awards covering the requirements of 1,000,000 men and including 8,700,000 articles. In this list was included, among other things, four miles of ponton bridge." Gen. Black adds: "All Engineer organizations that have left for France were fully equipped and the Engineer depot is still in position to meet any emergency calls which may be made upon it."

—Expeditionary Force for European War

See also

EUROPEAN WAR—LOSSES—UNITED STATES

[Note. *Army & Navy Jour.*, Dec 1, '17. 180 words.]

The Secretary of War states that the movement of our forces to France depends on the training and equipment of the men and the availability of ships. As fast as they are ready ships and men will be combined. As many American troops are overseas as we expected in the beginning to have there at this time. No official statement as to the number of American troops abroad will be given out during the war.

[National Guard Troops in France. *Army & Navy Jour.*, Dec 8, '17. 350 words.]

The 42nd or "Rainbow" Division under Maj.-Gen. William A. Mann, U.S.A., and the 26th or New England Divisions under Maj.-Gen. Clarence R. Edwards, U.S.A., have arrived safely in France without the loss of a man. This force of troops to augment those of the Regular Army already in France represents National Guard organizations from every state in the Union, and that they have been equipped and transported abroad so quickly reflects the highest credit on all concerned.

—History

See also

CIVIL WAR (U. S.)

EUROPEAN WAR

—Military Policy of

See also

MONROE DOCTRINE

[America and the Inter-Allied Conference. *Army and Navy Gazette*, Nov 24, '17. 1000 words.]

Mr. Lloyd George proposes that the Inter-allied Council should be advisory, decisions being communicated to individual governments, each of which in its turn shall communicate them to the generals in the field. But America, as we understand her, wants the supreme Allied organization for the direction and control of the war to have executive power. Without it she fears that while the machinery of the Conference may work more quickly and effectively in its new form than it has hitherto done, it will not work quickly and effectively enough in dealing with a combination in which authority is so highly centralized as it is in that commanded by Germany. What she wants is a unity in strategy and policy as complete as the enemy's, whereas what her European partners contemplate is a unity, which may be partly dispersed in the Council's discussions, and in establishing connection between it

UNITED STATES—Continued

and the other links in the Allied chain of responsibility. The difference is fundamental.

But if America's view were adopted, as indeed her leading men perceive, it would propose a Generalissimo in control of all the forces in Europe opposed to Germany, and he again in control of a statesman dominating the Council. Indeed, what she aims at is a direction of the war such as Chatham, Ligonier and Saunders exercised in the Seven Years' War, and Lincoln and Grant in the American Civil War. Any less concentrated form of authority she believes partakes of the debating society. It is possible that she is right. But it is doubtful if at this stage she could carry with her opinion in England, France or Italy, for while she might be perfectly willing to place her Armies under the control of a British Commander-in-Chief, for instance, difficulties might be raised by other partners in the Alliance. The truth is, the Inter-Allied Council is a definite step in the evolution of unity in the conduct of the war, which has been going on since the outbreak of hostilities, and, under pressure, may proceed in the direction indicated by the United States. With their logical faculty the French have perceived this, for responsible students of war amongst them have already proposed the appointment of a Generalissimo. If the Council does not fulfil expectations he is a possibility of the future then, so that there is a difference between the European and the American view of unified command only in point of time.

[Preparing for a Larger Army. *Army & Navy Jour.* May 4, '18. 850 words.]

That the General Staff is of the decided opinion that we should have larger forces in France is shown by the comment on this point in the course of the War Department's review of the military operations for the week ending Apr 7. The pertinent part of the review reads:

"The outcome of the present operations in the West depends on man-power. The Germans are relying principally on rifles, machine-guns—man-power—and carefully thought-out methods of transporting and supplying munitions to the front of attack under all conditions; which means that they have developed mobility of offensive action that can only be met by countermeasures of equal potency and flexibility. It must constantly be borne in mind that the enemy is seeking a decision that will end the war. This decision can only be arrived at by the destruction of the Allied forces in the field before fresh units contributed from additional levies in France and Great Britain as well as by our own troops can take up their position in sufficient numbers to turn the German successes to defeat. Ours is the imperative duty of providing replacement units for the armies in France. We must be able to put fresh men in the field thoroly and methodically trained. In addition to those already called to the colors and now training at our cantonments or already selected for service very large quotas will be required in the immediate future to fill the gaps."

—Military Policy of—Compulsory Military Service

[Universal Service in War and Taxation to Support It. By Maj.-Gen. William Harding Carter, U. S. Army. *Jour. Military Service Inst., U. S.*, Sept-Oct, '17. 5000 words.]

In accordance with the provisions of the Constitution, Congress, in 1792, enacted a law providing that "Every able-bodied male citizen of the respective States, resident therein, who is of the age of 18 years and under the age of 45 years, shall be enrolled in the militia." It further provided for a commanding officer in each district whose duty it was to enroll eligible members and notify them to attend muster. Thus was laid the foundation for universal service.

With a population nearing the hundred million mark, it will never be necessary to demand actual military service from every citizen, but it should not be left to the individual to determine whether or not he shall render such service or as to whether it shall be rendered in different industrial occupations and civil duties which must go on in war.

The abolition of the principle of universal militia service in 1903 and the substitution of a system embracing the National Guard or active organized militia, and the reserve or unorganized militia, comprising the untrained citizens of the country, has produced a number of creditable organizations in many states, but there has been no uniform distribution of military duty. The failure to reach the standard of strength and distribution anticipated caused the quota of each state to be determined by the number of Senators and Representatives from each state in Congress. Continued failure materially to increase the total strength of the National Guard led to a campaign for greater appropriations which appropriations have now been made.

The most careful students of the history of the Civil War were generally of the opinion that the system adopted by the Confederacy at an early period, under which the services of all able-bodied men were deemed due to the Government, was infinitely more business-like and fairer to the community as a whole than the volunteer system of the North. When the flower of the Northern youth had been swallowed up, then began a system of bounties and then conscription.

A re-establishment of the principles involved in the original militia law of 1792, and a practicable and enforced system of enrollment of a national force, would insure a fair and equitable distribution of the personal service due from each citizen for the protection of life and liberty and the pursuit of happiness guaranteed to him under the Constitution. In an age when ruptures of diplomatic relations come so suddenly something more than mere enrollment is essential.

Compulsory military service and taxation play a corelated and intimate part in national defense and should be considered together. The same universal obligation resting on all citizens of this country to defend it in time of war rests upon all citizens to support the Government thru the payment of uniform taxes. After imposing the income tax, the astonishing discovery was made that out of a population of nearly 100,000,000 only 357,515 have reported that they are in receipt

of taxable incomes. A tax which reaches so small a proportion of the people is undisguisedly class legislation. The numbers and geographical distribution of those reporting incomes of $3000 and over afford much food for reflection.

The enrollment of every qualified citizen for the nation's service, and provision for an income tax to include all men except those who have become public charges would fulfill not only the needs of the nation but upbuild a more self-respecting citizenship than will be possible under laws which breed class distinction on the basis of money. Individual studies have led many to the conclusion that we are in grave need of renewing our allegiance to the principles had in mind by the framers of the Constitution. Of these none is more clearly established than that of universal training for military service. A further study should produce the conviction that universal service should be paid for by a universal tax. Of all forms of public revenue for this purpose, a small income tax, without exception, addition or surtax, universally applied, is most commendable. In a republic no question should ever be regarded as finally disposed of until it is settled right.

[Universal Military Training. By Lt.-Gen. S. B. M. Young, U.S.A., Retired. *Infantry Jour.*, Nov, '17. 1600 words.]

Should the present war end tomorrow the United States would find itself with fewer men in arms that it possessed when war was declared upon Germany, and with no adequate legal authority for embodying new land military forces.

The act of May 18, 1917, provides only for the needs of the present emergency; and tho based on the principle of universal liability to military service, does not provide for universal military training.

Thousands of men are to-day being trained as soldiers, but should it be necessary to call more men for this war—or even future wars—the call would fall upon an untrained and unprepared citizenry. Thousands of men, since the registration of June 5, have come to the minimum age limit for liability to military service, but have no legal obligation upon them to accept military training to fit them for service in time of need.

Emergency legislation that provides only for the present emergency does not meet the full need of the nation: does not give any guarantee that "the world shall continue safe for democracy" after the present war has been won; and does not give us other than untrained men to take the places of those who will fall in this war.

The arguments advanced a year ago in behalf of universal military training in the United States are as true to-day as then. Men are being fitted for the present war, with no thought of the men who will fight our future wars. The selective conscription law bears no relation to the General Staff universal military training bill, in fact, it was not drafted by the General Staff, and it frankly takes no account of future needs.

The bulk of the Regular Army and National Guard, and all men raised under the selective conscription law are entitled to immediate discharge upon the termination of the existing emergency. The entire National Guard will disappear completely because the National Defense Act of July 3, 1916, provides that upon the drafting of the National Guard into the service of the United States, all connection with the state is thereby terminated.

Therefore, should the war end tomorrow we should have left only a skeleton organization of our Regular Army.

We must insure against new emergencies and that is best accomplished by an efficient military training of all physically fit young men. Should these men be never needed in defense of our country, this training would nevertheless be of lifelong benefit to every one of them.

—Munitions—Manufacturing Facilities

See
MUNITIONS—MANUFACTURING FACILITIES FOR—UNITED STATES

—Munitions and Munition Materials

[Work of Ordnance Department. *Army & Navy Jour.*, Apr 20, '18. 1800 words]

The following accomplishments of the Ordnance Dept in the past year are stated by the chief of the Procurement Division.

1. The production of Springfield rifles has reached 11,250 a day. To date 1,050,000 rifles have been delivered on contracts for 2,500,000 rifles of the modified pattern. There are 600,000 Springfield rifles now on hand. This volume of rifle manufacture is the greatest that has ever been carried on in the world, and has resulted in an excess over immediate needs, so that rifle factories are now being diverted to machine guns.

2. Contracts have been let for $70,000,000 worth of shells of all calibers. For the artillery 40,000 pieces of motorized vehicles are being produced at a speed now faster than they can be shipped. This item means an expenditure of $175,000,000. Powder plants are turning out 650,000,000 pounds of explosives, with smokeless powder being produced by two plants at the rate of 1,300,000 pounds a day.

3. Shortage of fuel and resultant shortage of steel have retarded the delivery of shells. This is disappointing, but recently the deliveries improved, so that in the last month manufacturers turned out 5,000,000 shells.

4. Contracts have been made for 1,350,000 automatic pistols. Deliveries to date totaled 264,000, and the production will rapidly overtake the needs of the United States troops.

5. Production of small-arms ammunition has already reached greater proportions than was ever reached in France or England. Last month production reached 270,000,000 rounds.

6. Machine gun production will not reach the designated production until July. To the troops 75,000 machine guns have already been delivered. Contracts have been let for 300,000 machine guns of various types. Difficulties arose in creating plant capacity for this

UNITED STATES—Continued

production, but by July 18,000 machine guns will be produced monthly.

—Naval Policy of

See also

AZORE ISLANDS

[Inland Waterways and National Defense. By J. Hampton Moore. *Flying*, Feb, '18. 1950 words. Illustrated.]

For many years we have been contending that those natural channels, which need a little digging here and a little digging there, in order to make them serviceable all along the coast from Maine to Florida, should be put in a state of preparedness for commerce as well as for war. We know that the Kiel Canal has doubled Germany's naval power. We have the unfortunate tendency in this country to lock the stable door after the horse is stolen. The project of connecting New York Harbor with the Delaware River across the State of New Jersey, is recommended by the United States Army Engineers. For the price of two battleships we could build a canal that would send battleships thru from New York to Philadelphia, from one navy yard to another, without going outside at all. The Chesapeake and Delaware canal affords commercial vessels a draft of ten feet. That canal passes more than a million tons of commerce every year. For the price of one battleship we could build a ship's depth canal from the Delaware to the Chesapeake which would complete a waterway union inland between the North and the South. If we can afford to spend billions for the construction of ships, why not spend a few millions on the rivers and harbors which must accommodate them along the coast. Even vessels of war cannot forever remain upon the high seas. Our small craft and our submarines certainly cannot. Taking the coast of Florida for example. Where would they go in case of storm or attack? The Florida coast is almost one-third the length of the entire Atlantic coast and the condition existing all the way up to Hampton Roads. With our vessels engaged at Panama, in the West Indies or anywhere else on the high seas, can you imagine how small that American "patr.ot" would be who had voted to prevent the vessels in New York Harbor from receiving assistance inland from the vessels in the Delaware River or the Chesapeake Bay?

URUGUAY

—Military Policy of

[Project of Organization of the Army of Uruguay. *Revista Militar* (Argentina), Sept and Oct, '17. 15,500 words.]

The first 24 articles of this bill relate exclusively to obligatory service.

Article 25 empowers the Executive to make reforms and additions in accordance with the approved military and naval program of 1915-1925 as follows:

(a) The acquisition of 50 batteries of 75 mm. rapid fire Schneider field guns, the first 25 batteries to be secured within three years and the second 25 to be secured within six years.

(b) The acquisition of the machinery, explosives and other material necessary, together with that already on hand in the Arsenal of War, to manufacture ammunition for the different arms; also to provide for the laboratory of submarine mines, and for the installation, in an appropriate building, of the Arsenal of War.

(c) The acquisition of 80,000 rifles of the model determined by the War Ministry.

(d) The procuring from France of a military mission of 15 officers to be charged with the reorganization of the national defense, and especially the General Staff, as well as to furnish schedules of instruction for the army.

(e) The formation of the military Cabinet.

(b) The establishment of military schools in Montevideo with courses of instruction for officers of all arms.

(g) The establishment of schools for non-commissioned officers in all units.

(h) General reorganization of the army under a new plan by military zones as follows:

3 regiments of infantry of 2 battalions of 3 companies of 90 men	1,620
1 regiment of cavalry of 4 squadrons of 100 men	400
1 regiment of artillery of 6 batteries of 120 men	720
For each zone	2,740
For the 4 zones	10,960
Engineers, pontoniers and firemen	300
Sanitary section	100
Telegraphers	80
Total	11,440

(i) Preparation for the immediate mobilization, upon the outbreak of war, of reserve elements of the active army as follows:

3 regiments of infantry of 3 battalions of 3 companies of 200 men	5,400
2 regiments of cavalry of 4 squadrons of 200 men	1,600
1 regiment of artillery of 9 batteries of 160 men	1,350
For each zone	8,350
For the 4 zones	33,400

Auxiliary, technical and sanitary troops aggregating 5750 men.

General total for immediate mobilization, 39,150 men and 144 cannon.

(j) Creation of cadres of officers and non-commissioned officers for auxiliary services of the reserve.

(k) Acquisition of various classes of material for the auxiliary, technical, and sanitary services.

(l) Division of the country into military districts determined according to the number of men of military age are assigned to each arm annually by the Ministry of War.

(ll) Determination, by departments or by military districts, as the Ministry of War shall decide, of the quota of conscripts in the Categories (Active, First Reserve, Territorial and Territorial Reserve) that shall be assigned to each arm. Designation of instruction and mobilization centers, and assignment of Cate-

gories to the various arms in accordance with the following plan: (Totals only are given.—Ed.)

Active Army.	Active Army Reserve.	Territorial Army.	Territorial Reserve.	Total.
11,440	65,781	26,000	20,950	124,171

(m) Dissolution of the Machine Gun Corps and distribution of the personnel and equipment thruout infantry units.

(n) Creation of a Ministry of Marine independent of other departments.

(o) A study of the General Staff plans of coast defense by the French Military Mission referred to before and acquisition of such coast batteries and construction of such fortifications as may be declared necessary by this mission at Montevideo, La Colonia, Maldonado, the mouth of the Uruguay River and other points.

(p) The acquisition of two mine planters of a speed of at least 26 knots, and of a minimum of six destroyers and ten submarines of types to be decided upon by the commission designated by the Ministry of Marine.

(q) The acquisition of an Aerostation Park with a minimum of twenty airplanes, and all elements necessary for their maintenance and repair.

Article 26 provides for a *National Defense Tax* of fifteen cents annually upon all inhabitants of the country.

Article 27 authorizes the Executive to contract a loan of 13,000,000 of pesos to meet the expense of putting into effect the Military and Naval Program of 1915-1925, this sum being exclusive of the ordinary appropriation for military and naval purposes.

The motives for adequate preparation for national defense are not difficult to understand. It is not necessary to be an expert politician, to have studied the history of this and the neighboring states, nor to possess the science and art of a great general, to comprehend that Uruguay, located as she is between Brazil and Argentina, would be directly attacked, annihilated economically and her sovereignty destroyed, as a consequence between these powerful nations.

Should such a war come to pass the territory of Uruguay would be the principal theater of operations.

The Republic of Uruguay has a population of about one million, Argentina has about six millions, Brazil has over twenty millions.

The permanent army of Uruguay has a strength of fifteen thousand men, counting military police; that of Argentina, twenty-two thousand men; that of Brazil, including the gendarmerie, something over forty thousand men. The motives for military and naval preparation may be summarized as follows:

(1) The indications are that the duration of peace in America for a long period is more than doubtful.

(2) The supremacy of the continent is in dispute between Brazil and Argentina, whose armies in case of war must converge upon Uruguayan territory, the logical theater of operations.

(3) Uruguay has questions of vital importance at issue with adjacent states of far greater population and military strength.

The tragic fate of Belgium, a buffer state, is a fitting example to place before those misguided individuals who venture to oppose the work of national defense for Uruguay.

Belgium had a line to defend only 75 kilometers in length; she had fortifications; she had brave men ready to die in her defense but she lacked the essential, she lacked soldiers. She had not obligatory service in the proper concept of the term. The base of all military organization rests upon obligatory service. The institution of obligatory service is of no value, however, unless the masses of adults who have passed the age of conscription are organized into reserves. The reserve of the active army of Uruguay constitutes, with the permanent army itself, the hope of the country in case of war. This should number when fully mobilized some 90,000 "elite" troops. Corresponding to the first category of the French Army, the permanent army of Germany and the first "base" of the Swiss "Auszug."

In spite of their numbers and value these forces would not be sufficient to defend the 500 kilometers of frontier and to replace the wastage of war. A second reserve is therefore necessary, the Territorials, formed of men 35 to 43 years of age. The Territorials should number from 26,000 to 30,000 men.

After mobilization this force should unite with the "elite" forming a mass of from 116,000 to 120,000 men of the first and second lines.

The Reserve of the Territorials, composed of veterans of from 44 to 50 years, and of partially trained young men of 17, should constitute a fourth army of approximately 21,000 men, corresponding to the "landsturm" of the Swiss.

Switzerland includes in her "landsturm" men of 52 and Montenegro in the third "ban" of her reserve, men of 62.

French officers trained the Bulgarian, Servian, and Greek armies that in the Balkan wars astonished the world. French officers also trained the army of Peru. They are the officers who by their military science, historical prestige, knowledge of the art of war and heroic example, are best entitled to be admired and imitated.

France without doubt would help Uruguay to become a military republican nation.

Uruguay must look to France for direction, men, books and artillery.

Fifteen or twenty French officers should be engaged and entrusted with the reorganization of the General Staff, plans for war, and with all branches of military administration.

VACCINATION

See
SMALLPOX

VENEREAL DISEASES

[The Combat Against Disease During the War. By Col. C. U. Dercle, M.C., French Army. *Military Surgeon*, June, '18. 5300 words.]

VENEREAL DISEASES—Continued

(A lecture delivered before the Southern Sociological Congress at Birmingham, Ala., on Apr 15, '18.)

Col. Dercle touches briefly upon a number of phases of the work of the French military surgeons during the present war. Among the most interesting figures quoted are those concerning the prevalence of venereal diseases in the French Army, since they authoritatively set at rest the exaggerated rumors which have been spread so widely, alleging an enormous increase in cases of this kind. Just before the war the Army of France had 21 per 1000 cases of venereal dsease, and the Army of Africa 69 per 1000. The official figures of December, 1917, show that the Army of France now has 14 cases per 1000 and the Army of Africa 26 per 1000. This shows a notable decrease instead of the enormous increase that had been rumored.)

VETERINARY SERVICE

See also
HORSES

—Organization and Adminisration

[The Army Veterinary Service. By Maj. J. W. Rainey, R. of O.A.V.C., British Army. *Jour. U. S. Cavalry Assn.*, Apr, '18. 10,000 words.]

The existing war is the first in which the British Veterinary Service has been permitted and assisted to carry out a scheme of its own for more efficient service.

To show what this scheme has accomplished the total wastage among horses and mules (deaths, destructions, missing, and condemnations) in the British forces at home and abroad for the year ending Dec 31, 1916, was thirteen per cent of the animal strength. The same percentage during peace times was 14.8 per cent.

In the South African War of 1899-1902, the same loss amounted to 55 per cent per annum. For the German S. W. African Campaign, the annual mortality for British forces was 9.09 per cent.

The work of the Army Veterinary Service comprises:

1. The examination for soundness of all animals prior to their purchase for the army.
2. Care of remounts on board ships.
3. Prevention and control of contagious and other disease among army animals.
4. Treatment of minor sickness and wounds under regimental arrangement with the unit to which the animals belong.
5. Evacuation to veterinary hospitals of other cases.
6. Maintenance of an efficient standard of horseshoeing thruout the army.
7. Supply of veterinary medicines and equipment.
8. The training in Schools of Farriery of shoeing-smiths and cold-shoers for the army.
9. Careful observance of and advice upon all matters concerning the welfare of the army animals, *e.g.*, stables, forage, feeding, etc.

The policy of the Army Veterinary Service is well expressed in the adage "prevention is better than cure."

To carry this policy out the horse must be inspected at least once daily by the professional eye. Influenza is one of the equine disease whose earlier symptoms are most difficult of detection by the less experienced observer. Amounts are peculiarly liable to this kind of disease and the rule is now enforced by the A. V. S. that no remount is shipped or transferred from a remount depot unless his temperature has been ascertained to be normal not later than the day before shipment.

Horses on Board Ship

At the outbreak of the war, it became evident that a large number of animals would have to be purchased in other countries and brought to England by sea. The Veterinary Directorate at the War Office undertook to provide veterinary surgeons to take charge of the animals during the voyage. Veterinary surgeons were also sent out with the buyers to examine animals before purchase, and to make such subsequent arrangements as would ensure that only healthy animals were placed on board ship.

One surgeon and a carefully selected lay assistant were allotted to each ship carrying horses or mules. After one year's experience it was found possible to leave the assistants in charge, freeing the surgeons for more important work. Another notable improvement in this connection was adopted whereby animals are carried free in pens, five animals to each, instead of one animal to a stall with a width of two feet six. The pen gives freedom of movement, better facility for sanitation, etc., and even permits some animals to lie down. Also less timber is used, cutting down cost. Losses have thus been reduced from three to less than one per cent.

Work of the Army Veterinary Corps at the Front

The work at the front is largely of a preventive and first-aid nature. In each division, in addition to a Mobile Veterinary Section, there is a definite number of officers and non-commissioner officers of the A. V. C. distributed with regiments as is the medical personnel of the Medical Corps. These officers and non-commissioned officers carry out first aid and inspections, and decide what cases are to be turned over to the Mobile Veterinary Section of the division for evacuation to veterinary hospitals on the lines of communication.

Open wound dressing is necessarily for the most part practised on the field. Bandaging is only practicable to a small extent on the lower extremities of the limbs. It has been found better to enlist the bactericide aid of the oxygen of the air.

What is probably the best form of field dressing for horses is as follows:

Foreign bodies are removed from the wound without probing. Shreds of damaged tissues certain to die and decay if left inside are similarly removed with the dressing scissors. The wound is then gently cleansed with antiseptic wool, facilities for downward drainage of discharge are established and the dressing is completed by painting all exposed tissues with tincture of iodine. If it is evident that the animal cannot be restored to usefulness within a reasonable period he is painlessly destroyed on the spot.

The Mobile Veterinary Section corresponds in many ways to the Field Ambulance Section of the Medical

Corps. It collects all cases to be evacuated to the veterinary hospitals and it transports from the base to the front lines medicines and equipment. Half the section is utilized in collection of sick and first aid treatment including injection of tetanus anti-toxin, if necessary. The other half, known as the Railway Conducting Party, is responsible for safe conveyance of the patients to the base. On its return from the base this party brings up veterinary supplies. When the division is stationary, milder cases are treated by the section without further evacuation.

Veterinary Hospitals and Convalescent Horse Depots.

These are situated on the lines of communication and at the various bases of the expeditionary forces, in addition to many established in home commands. There are now about thirty such, apart from camel hospitals and convalescent horse depots, each prepared to care for 1250 cases and capable of expansion. Each hospital is subdivided into wards and each ward is appropriated to the treatment of a separate class of injury or disease.

Much trouble has been experienced with parasitic skin diseases. One veterinary hospital with the B. E. F. is practically confined to the treatment of this disease alone. Caused by a microscopic insect parasite which attacks the skin and, in one species burrows under the surface of the skin, each case had formerly to be treated by hand. Now long trenchlike baths are used, lined with concrete and filled with a solution found most efficacious for the destruction of the mange parasite. The temperature necessary for the best results is kept constant by the use of steam. Mange is now only a nuisance in the British Expeditionary Forces.

Eighty per cent of all cases of disease, including wounds, admitted to the veterinary hospitals are now returned to duty in due course. Of the other twenty per cent a considerable number are killed and sold to the inhabitants for food. Horses between six and twelve years stand hardships best.

Besides the medical care of 1250 animals, they must be fed, shod, groomed and exercised so that they will be fit for duty when discharged. When discharged they are sent straight to the remount depots. Thus the personnel of a hospital consists of 400 officers and men. Shelter and moderate warmth are necessary in the restoration of condition to animals, and all hospitals are provided with facilities giving both.

In 1914, the Army Council accepted a fund from the Royal Society for the Prevention of Cruelty to Animals for the purchase of hospital requisites for sick and wounded horses. The fund has up to the present collected over £100,000 which has been spent as directed.

The first hospital built in 1914 was for 1000 horses and was constructed of wood and galvanized iron, with wooden mangers and water troughs. It was found that wooden structures required a great deal of repair and it was also thought that in case of advance or retirement the steel constructed shelters would be advantageous as they could be unbolted and removed. So the later hospitals have been built of steel or cast iron, each building accommodating 50 horses.

Glanders and Mallein

Glanders, a deadly equine disease and highly infective, spreads rapidly among debilitated animals. An adequate means to stop it exists in mallein, a substance composed of killed cultures of the glanders bacillus to which has been added glycerine and carbolic acid. When mallein is injected, hypodermically, under or into the skin of a horse affected with glanders, a reaction takes place in which a swelling forms at the site of inoculation and a marked rise of temperature occurs within 24 hours. If the horse is not affected with glanders no reaction occurs. As glanders may lie dormant in an apparently healthy horse for months, the value of this test is apparent.

By the frequent use of mallein in this war the mortality from glanders has been less than one per cent of the total mortality from equine disease. The test is applied at every period of the animal's career found from past experience to be associated with disease. Mallein is prepared at the laboratory of the Army Medical School at Aldershot.

Discoveries of French veterinary surgeons disclosed that two drops of a differently prepared mallein injected into the eyelid gave a more certain test. The former dose had been 15 drops injected in the skin of the neck. If an animal is glandered. a swelling of the eyelid speedily occurs, accompanied by a more or less profuse discharge from the eye; no reaction is seen in the healthy animal.

Horse Ambulances

Motor horse ambulances and horse-drawn vehicles are used with great success, especially for foot wounds from picked up nails. These in France alone number several hundred a week.

Army Schools of Farriery

A set of shoes will often last a gun team for only five days' constant but not severe marching, and an unshod horse is useless. During the first year of the war the supply of ready made blacksmiths suitable for the army was comparatively small, due to the advent of the motor car. The question of training was taken up eagerly, and classes of instruction were started in veterinary hospitals, remount depots, etc. The Cavalry and Army Service Corps also established schools. As might be expected, this developed a grave lack of uniformity in the degree of efficiency displayed by the newly trained men.

The difference between a "cold-shoer" and a shoeing-smith is one of degree, in which the latter has the advantage. The cold-shoer can only take off and nail on shoes and carry out "minor repairs." The shoeing-smith is a complete artificer, able to make a shoe as well as put it on.

In 1915, three schools of farriery were formed in England by the Army Veterinary Department of the War Office. Each school was capable of turning out 1000 cold-shoers every three months. A small school of farriery also was established in France. These schools have been working since the winter of 1915-16 with great success.

The schools are located near remount depots and large garrisons, so that the supply of horses for instruc-

VETERINARY SERVICE—Cotinued

tion may be sufficient. Retired army farriers are used as assistant instructors. A short course in first aid surgery of the horse's foot forms part of the course. After two months in the school, and after passing a satisfactory examination, the candidate becomes a "cold-shoer." Not less than three months additional training are needed to make a "shoeing-smith."

WAR

See also
STRATEGY

—Cost of

[The Principal Wars, 1861 till 1905: Their Causes, Costs, and Consequences. By T. Miller Maguire, LL.D., F.R.H.S., Order of the Rising Sun of Japan. *United Service Mag.*, May, '18. 4500 words. One Table.]

(A brief summary of the causes and results of the War of Secession, 1861-65; Prussia and Italy against Austria, 1866; Franco-German War, 1870-71; Russo-Turkish War, 1877-78; and the Russo-Japanese War, 1904-5.

Reference is made to Clausewitz's "On War," which is recommended for study. Clausewitz declared that "no doubt war will not take henceforth such enormous proportions" as in the Napoleonic wars, but modern wars have shown many as mighty and terrible struggles. Follows in tabular form approximate estimates of the cost of and casualties in eight wars, given below.)

Parties	Cost	Loss in men
1854-56, Crimean War	$1,525,000,000	485,000
1859, France and Austria	225,000,000	63,000
1861-1865, American Civil War	5,500,000,000	500,000
1866, Prussia and Austria	100,000,000	51,000
1870-1871, France and Germany	2,500,000,000	290,000
1864-1870, Brazil and Paraguay	240,000,000	330,000
1877-1878, Russia and Turkey	950,000,000	180,000
1904-1905, Russia and Japan	1,000,000,000	490,000

—Laws of

See also
ESPIONAGE

—Moral Forces in

See also
COMMAND OF TROOPS (Article: "Evolution of Intellectual Activity in the Commanders of Small Fractions")

WAR CORRESPONDENTS

See also
PRESS CENSORSHIP

WATERLOO, Battle of

[The Enigma of 1815. By J. W. Chambers. *United Service Mag.*, June, '18. 5000 words.]

(A discussion showing the relations of Fouché (Duke of Otranto) and Carnot to Napoleon. Develops the idea that Wellington was deceived as to both the time and place of Napoleon's attack by false information from Fouché. A study of the Waterloo Campaign tends to shake the student's faith in the accuracy of history in general. Wellington said to Napier that "To tell the truth about Waterloo would be impossible, without doing as much mischief as Bonaparte himself had done."

The following statements can be substantiated by unimpeachable evidence: (a) Wellington believed that Napoleon would not leave Paris before July 1; (b) He also believed the attack would be made via Mons and threaten Ghent and the overseas communications; (c) Wellington also believed that any attack via the Sambre and Meuse would be a feint; (d) and finally, Wellington expected information thru the agency of "Madame D——" who was apparently an agent of Fouché, started by him but held up by his instructions at the frontier until the information she conveyed was too late to be of use. Wellington did not know of Fouché's connection with his sources of information. Wellington was deceived as to Napoleon's intentions, but Napoleon failed to appraise Wellington at his true value.)

WATER SUPPLY

[Tarpaulin Water Tank. By Lt.-Col. A. A. Crookshank, R.E. *Royal Engineers Jour.*, Jan, '18. 500 words. Plates.]

This reservoir was designed, on field service, to take a 30 ft. x 30 ft. canvas tarpaulin. The capacity of the reservoir is about 11,500 gallons. The ruling dimensions are: Depth, 4 feet; sides, 21 feet; height above ground, 12 feet. With a tarpaulin of this size a depth of about 5 feet gives the maximum capacity. In actual construction in the field the 5 ft. depth is too expensive and requires too heavy materials if the tank is to be elevated. The 4 ft. depth was adopted as more practical.

The reservoir, as designed, has a wooden frame work, lined with corrugated iron sheets to support the canvas. The canvas should be hung loose; this greatly lessens the strain. The tarpaulin and corrugated iron should be tarred both sides.

The tarpaulin is liable to be moved out of position by wind pressure when the tank is empty or nearly so. It is, therefore, held in position by a skirting of 4 in. x 3 in. timber, with one corner rounded off, around the edge of the floor, and by 3 in. x 3 in. vertical posts at each corner and at 7 ft. intervals along the walls. The corner posts have one corner rounded off.

With foundations of the floating raft type, drainage is important; all surface water must be run off rapidly. The site should be protected by a barbed-wire fence.

—By Motor Tanks

[Mobile Water Trains for the Army. *Army & Navy Jour.*, June 29, '18. Quoted.]

In order to provide pure drinking water for the soldiers in sections where permanent water works have not been established, mobile water trains have been constructed and are now operating in France under the jurisdiction of the Medical Department of the Army. These trains are miniature water works which chemically treat, filter and sterilize water, making it fit for consumption. They do everything that a municipal

water works does to provide pure water to the people of a town or city. Chemical treatment and filtration remove those substances that make water muddy and discolored. The filtration process also removes a certain number of germs. The removal of the germs is accomplished by applying liquid chlorine, the agent almost universally used in the sterilization of water. Chemicals are also added to dechlorinate—remove excess of chlorine that gives the water an unpleasant taste.

Several of these purification units with their attached motor tank trucks constitute a train. Each unit is mounted on a motor truck and is a complete filtration plant including laboratory. Arriving at a stream it sets hose into the water and then pumps the water thru a pressure tank. Before the water passes thru the sand filter it is chemically treated. When the water is passed out of the truck it is free from all disease germs. The pure water is pumped into tanks mounted on trucks which carry the water to the soldiers. Each mobile unit carries an expert chemist, bacteriologist and pumpman. There is a complete laboratory in the front of the machine for the testing of the water. Tests are made every two hours and oftener when it is thought necessary. The water is lifted into the filter by a gasoline pump engine, and a complete supply of extra dry pipes and tools are carried so that all repairs either from accident or shell fire can be made on the spot. The trucks are equipped with electric lights so that the work can be carried on at night. Many of the chemists and bacteriologists assigned to the mobile laboratories were formerly connected with municipal water works and filtration plants. These purification units are operated by the personnel of the Sanitary Corps of the Medical Department.

—For Horses

[Horsewater Troughs and Horsewater Points. By Capt. H. S. Briggs, R.E. *Royal Engineers Jour.*, Dec, '17. 500 words. 1 plate.]

Altho horses can approach a waterpoint across country in dry weather, experience has shown that they must be allowed to use the roads in wet-weather. The waterpoint should, therefore, be sited on a by-road. Long approach standings are then unnecessary and the point can be placed right alongside the road. It should consist of two, or at the most three, canvas 600-gallon troughs. Each trough will water about 300 horses per hour. Large waterpoints watering thousands of horses per hour are a mistake.

The 600-gallon trough made of canvas and supported by a timber backing is believed to be the best. The frame can be made of timber found in ruined villages so only the canvas must be transported. If the trough is to last it must be supported sides and bottom. The canvas soon rots if allowed to take the weight of the water. A raised floor of some kind of metalling should be provided, giving a slope outward each way, with a shallow trench all around.

The waterpoint should be surrounded by a substantial fence made of posts and timber rails, with suitable openings for entrance and exit.

WEATHER, Military Aspects of

[King Weather Rules the War. *Popular Science*, Apr, '18. 1500 words. Illustrations.]

The weather has always been a prominent factor in warfare, and often a decisive one. In the present conflict it has assumed an even greater importance than ever before, on account of the addition of aircraft to the world's armaments; the use of asphyxiating gases, borne by the winds; the effect of extreme heat and cold upon the operation of internal combustion engines; the relation of rainfall and the freezing of the soil to the construction and maintenance of the trench systems; and, indeed, in a host of ways which did not enter into military calculations a few years ago. The old enemy—mud—is still, however, as it has been in the past, one of the most troublesome of the manifestations of the weather affecting warfare.

(Instances of the way the weather has influenced military operations in former wars and in the present one are cited.)

In view of past experience it is strange that the strategic and tactical value of weather science and weather prediction were not sooner recognized. This is the first war in which meteorology has played any definite part. At the very beginning of the war the Germans put into the field a well organized weather service. In Belgium the Germans promptly took possession of the Royal Observatory near Brussels, and made it the center of their meteorological organization. The Allies soon adopted a similar idea, and now have a well organized system of weather forecasting on all fronts. The only precedent for such undertakings lies in the establishment by the United States, during the Spanish-American War, of observation stations encircling the Caribbean Sea for the information of the American fleet.

(The Western Allies have a great advantage over the Germans in forecasting the weather on the western front, since practically all of the storms in western Europe come from the west and northwest. The Germans are, of course, unable to get news of the movements of the storm centers until their effects begin to be felt on the front.—Ed.)

There is an interesting historical connection between weather forecasting and warfare. In November, 1854, a tremendous gale struck the Crimea, and shattered the camps of the Allied forces there. The French astronomer Le Verrier made a careful study of this storm. By collecting the weather records kept in various parts of Europe, he was able to trace its course as it swept in from the Atlantic and moved slowly across the continent. He saw that, by means of telegraphic reports, it would have been an easy matter to have kept track of the storm's progress and to have given timely warning to the Allied forces. The idea was submitted to Napoleon III., and was soon put into operation. Thus weather forecasting received its first great impetus from the exigencies of war, and modern meteorologists are but repaying their debt to Mars.

WESTINGHOUSE FRICTION SHOCK ABSORBER

[The Westinghouse Friction Shock Absorber. By Juan Casado Rodrigo. *Memorial de Ingenieros,* Jan, '18. 3000 words. 15 plates.]

The considerable expansion of railroad traffic in recent years has carried with it a corresponding change in the rolling stock. The light locomotives have been replaced by more powerful ones, capable of pulling longer and heavier trains. The increase in the number of couplings per train and in the weights has caused reactions hitherto unknown. The principal parts of the train, with the one exception of the couplings, have all undergone considerable improvements and modifications in recent years.

The couplings now in use are provided with springs, whose object is to reduce the shock of transmission of the forces to which the cars and couplings are constantly being subjected. An ordinary spring, however, can not reduce the force which it transmits, or absorb it, but must transmit it in a wave-like, successive condition which may be more dangerous than the original condition would have been. This old, inherent objection has in recent years greatly increased in importance, causing results which are not merely annoying to passengers and damaging to freight, but also very injurious to the cars themselves. In Europe an effort has been made toward improvement by increasing the power of the springs, but this has really caused more serious objections by transmitting more powerful reactions, and on account of their method of fastening the increase in weight has increased the difficulties of operation. In the United States of America, the size and intensity of traffic have forced the adoption of other solutions, causing the employment of coupling apparatus hitherto used for other purposes to reduce the shocks of operation of the trains.

The Westinghouse Friction Shock Absorber was designed to meet this condition. It works along new lines, transforming into heat, caused by friction, nearly 80 per cent of the shocks which it receives; consequently, it transmits only a small portion of these shocks. Another advantage of these absorbers is that they can be constructed to handle strong thrusts without necessitating great cost and weight.

(A description of the shock absorber is given.)

The simplicity of its construction, the very general use of castings, and its small size combine to make it very economical and satisfactory. To handle forces up to 64,000 kilograms intensity requires an apparatus only 225 millimeters in diameter, for 34,000 kilograms one of 172 millimeters diameter.

This apparatus as used in the United States and in Canada has proven very satisfactory after extended trial. In Europe, on account of differences in the construction of the rolling stock, it has been possible to use shock absorbers which are very much smaller in size and weight, consequently much cheaper. It has been found that by equipping only a portion of the cars of a train with these, the shocks incidental to starting and stopping can be very much decreased. They have proved especially valuable for the protection of the locomotives from the shocks formerly transmitted to them from the leading cars of the trains.

WIRELESS TELEGRAPHY

[To the Radio-Telegraphers of America. By William Marconi. *Memorial de Caballeria,* Feb, '18. 2000 words.]

One of the most prominent deficiencies which I discovered in my official trip to America was the deplorable ignorance of American radio-telegraphers with respect to conditions in the theaters of war.

For example, American telegraphers consider the portable wireless set more or less of an innovation whereas on the western front they have come into general use, and in the trenches they are practically indispensable. The portable set varies in form from the most complete sending and receiving set to the simplest single coil sending outfit.

Another impression amongst Americans is that radiotelegraphy has not been a very great factor in the world war. This is entirely wrong. It is sufficient to say that since the fourth month of the war radiotelegraphy has been practically the only means of communication in the front trenches.

Neither telegraph nor telephone are used in the trenches close to "No Man's Land"—because the wires are being constantly cut by the bombardments. A visit to the trenches to-day would show that they are occupied mainly by radio-telegraphers—and not by the infantry, who only come forward when an attack is pending. For the most part the defensive lines are garrisoned by small detachments with machine guns at about 400 yard intervals, each detachment having its radio operators with their portable set.

At the beginning of the war the Allies had a great deal of trouble in securing the necessary number of wireless telegraphers; but most of the Allies had large standing armies and it simply became a process of picking out soldiers and training them in these special duties.

On the other hand, America has men with technical knowledge in great abundance, and the task of training American radio-telegraphers is a much simpler one than ours was.

The United States will do a great service in sending to France the greatest number of telegraphers at the earliest time.

There are great numbers of wireless operators in France, but there are not enough to carry out all the varied services which are now demanded of them. The necessity has been so great that we have taught many men to send messages only, and with this knowledge they can be used in many capacities when a receiving knowledge is not required.

As to the direction of artillery fire, the idea in the United States seems to be that the airplanes direct the fire by means of visual signals to the batteries. Nothing could be more incorrect. The fact is that the fire of all our heavy artillery is directed from airplanes by means of wireless telegraphy. In the first days of the war we had neither the equipment, experience or personnel for this work and it was customary for the

aerial observer to draw a careful map of the enemy's emplacements, which was then dropped down to the batteries. To-day each round fired is observed and corrected by the airplane observer who sends his correction thru his wireless set.

The radio-telegrapher who observes artillery fire is provided with a map of the terrain which is divided up into squares. When he observes the point of impact of a projectile he sends the number corresponding to the respective square on his map over the wireless and at the same time rectifies the fire so it will fall on the target.

American telegraphers are admirably prepared to take part in the many duties of wireless operators because they are for the most part young men who are experts in short wave length, low tension transmission. Most of the military work is done at wave lengths under 200 meters.

The United States has a great reserve of young men —over 16 years of age—who have received a fairly uniform instruction in wireless telegraphy and who should be able to meet the military requirements in this respect, which include an ability to send and receive at the rate of 20 words per minute. Altho the present laws place the lowest age limit of telegraphers at 18 years—I can see no reason why boys of 16 years should not be acceptable.

Germany

[Wireless Telegraphy in German Trenches. By "A." *Memorial de Artilleria,* Apr, '18. 400 words.]

In order to avoid a break in communications between first line trenches and posts to the rear, which usually occurs during a bombardment by having telegraph and telephone wires cut, the Germans are making use of a trench wireless set.

The antennae of this set is made of wire 100 meters long and fixed four meters above ground. The Germans use a wave length of between 300 and 600 meters. There are upwards of 110 wireless stations on the eastern front.

WOUNDED

[Prevention and Treatment of Delayed and Faulty Union of Fractures. By Capt. W. A. Clark, M.R.C. *Military Surgeon,* July, '18. 4800 words.]

Were it possible to treat all fractures under ideal conditions from the beginning, nothing would need to be said on the subject of delayed union and malunion, for such results would not be fouud. However, all surgeons will at times have bad results in fracture treatment, some unavoidable but others avoidable. The problem is the same in principle whether encountered in military or in civil practice, but the details differ on account of the more extensive wounds and the greater frequency of infection in military experience.

Fractures do not heal firmly in the classical times alloted by the text-books, even in cases of simple fractures. With compound shattered fractures so often met with in war, the total time of non-effectives due to fractures becomes a very important element. Hence the necessity for the utmost care in treatment to preclude delays and reverses in the course of repair of every fracture. There is no other type of wound which requires a longer time to repair before the soldier can be returned as a fighting man, and few others more likely to render him permanently non-effective.

(The author proceeds to a technical discussion of his subject, unsuitable for condensation, but valuable to the military surgeon, who should consult the original article. The importance of prevention is emphasized and the principles of treatment are outlined. The paper is based largely on the author's observations during five months' service in the Belgian Red Cross Hospital at La Panne.)

—Instruction and Training of

[Hospital Schools for Crippled Soldiers. By D. C. McMurtrie. *Modern Hospital,* Apr, '18. 4500 words. Illustrations.]

We have failed, in the past, in the after care of the crippled soldier. With a limb amputated at a field hospital, the best the man could hope for was treatment of the stump until it healed, provision of some makeshift artificial member, and the award of a pension. The latter was too small for decent support, and it generally left a seriously disabled man semi-dependent on relatives and friends, or slated to become an inmate of a soldiers' home.

The idea that the disabled man should be rehabilitated economically and socially is of comparatively modern origin. The new conception is that the cripple must again be made useful, and, altho prevented by his handicap from pursuing his former trade, must be trained for a new one in which his disability is no handicap. A cripple is a cripple only in the sense that he cannot perform the duties of his daily life. If these duties can be chosen to fit his range of capability, his handicap literally disappears.

Early in the course of his treatment at a base hospital, the soldier's interest in life is again aroused by simple forms of occupation. As the physical condition improves, the vocational work is taken up. A difficult task here is to enlist the soldier's interest and enthusiasm. The man's confidence and friendship must be gained; his discouragement overcome.

In the present inflation of the labor market, even disabled men may be able to obtain temporary jobs at high wages, from which, however, they would be displaced at the end of the war. This constitutes a great temptation to the men to refuse the training opportunity. They must be shown the future consequences and be brought, if possible to make the right decision.

In selecting trades in which instruction is to be given, there should be sought those which fulfil the following conditions:

1. Of standard character, in which employment opportunities are numerous.
2. Trades which are growing rather than on the wane.
3. Trades which are not likely to slump at the close of the war.
4. Those not subject to seasonal variation of employment.
5. Those in which the wage scale is reasonably high.
6. Trades which can be taught satisfactorily within

WOUNDED—Continued

a reasonable tuition period to the pupil of average intelligence and capacity.

In picking out the trade in which a cripple is to be instructed, the first limitations will be indicated by the type of his handicap. Within the possible range, the man's personal preference should be consulted. The most important determinative factor is found in his past experience. The greater part of an adult's education has been gained in the course of his employment. In planning for the future this former experience must be conserved and built upon rather than discarded.

(The writer then proceeds to a brief description of the French, British, Italian, German and Canadian methods of economic rehabilitation. He believes that, with the European experience in view, the United States should be able to even improve upon the work that has been done elsewhere.)

WOUNDS

See also

Amputations
Gunshot wounds
Surgery, Military
Wounded

[An Analysis of the Problem of Infection. By Capts. J. L. Stoddard and S. C. Harvey, M.R.C. *Military Surgeon,* May, '18. 450 words.]

During the last three and a half years the main factors which enter into the infections of war wounds have become fairly clear. The portion of the American Medical Corps serving with the British has had an unusual opportunity for gaining a knowledge of the present method of study and treatment of wounds. Now that this preliminary experience has been gained it is time for a critical study of the situation. The methods which were started before a complete analysis of the problem was possible have in some respects lagged behind the knowledge acquired, due to the necessity for treating cases in great numbers with rapidly developed faclities, and to many other causes.

The present is a critical moment for the concentration of thought on wound infections since the main facts are no longer obscure, previous experience has shown the limitations of the previous methods of attack, and the advent of a new body of medical men makes especially apropos a new attempt to solve the problems.

(There follows an outline of a method of analyzing the main and secondary factors of the problem of evolving a method of treatment likely to be successful, and of deciding which of any two given methods is the preferable for a given case. A thoro analysis of the problem is, of course, the first requisite. The authors state that they have not attempted such an analysis, but merely to indicate a method of attack.)

—Treatment of

[The Case for the More Efficient Treatment of Light Casualties in Military Hospitals. By Maj. R. I. Lee, M.R.C. *Military Surgeon,* Mar, '18. 1900 words.]

Altho theoretically every sick and wounded soldier deserves to be cared for in a hospital bed in a hospital ward, yet practically this is impossible in times of military activity. Furthermore, many of the wounds and ailments of the soldier are so trivial that hospital ward treatment, as that term is generally understood, is not necessary. In practically all military hospitals the serious cases are admirably looked after. One cannot fail to be impressed with the fact that the best surgical and medical skill and the best nursing are devoted to the care of men who will very likely be cripples for the rest of their lives. From a military point of view, these men are of no future value.

Of course these men who have been maimed in the service of their country should receive every possible attention. On the other hand, the lightly wounded case, and the case with a trivial medical ailment, are too often looked upon as unworthy of the best medical and surgical skill in comparison to the more serious cases. It is obvious that for military purposes the slight casualty is a real asset, and the promptness of his return to duty will go far to increase military efficiency.

(With these statements as a basis, the author goes on to develop his argument for more minute attention and the employment of the best possible skill in the treatment of the light case. It is believed that the most feasible solution of the problem is the establishment of an out-patient or dispensary department in connection with every military hospital.)

X-RAY

—Equipment

[A Convenient X-Ray Illuminator. By W. T. Bailey, M.D. *Modern Hospital,* Feb, '18. 750 words. 2 figures.]

Many X-ray plates which are valuable for hospital records become cracked or broken in cases where it is impossible to obtain duplicates. Especially is this likely to occur when the radiographs are examined by a number of persons. To reduce this breakage to a minimum and at the same time permit of a more satisfactory view of the radiograph, a very simple method has been devised.

This consists of a wooden box, the ends of which are equilateral triangles, 17 inches on a side. The material is seven-eighths inch hard wood, shellacked on the outside and painted white on the inside. The front face of the box is a ground glass plate, at the bottom of which is a wooden strip to hold the X-ray plate. The top of the radiograph need not be fastened, since it rests upon an inclined surface.

In the corner of the box opposite the glass plate is nailed a strip of wood 2¾ inches wide, running the entire width of the box; between this and the corner is a space for the electric wires. Mounted on the strip is a 100-watt nitrogen daylight lamp, with a switch on the outside of the box, and a long cord with a screw plug for attachment to any ordinary fixture.

The diffusion of the light is increased by pasting on the inside, about 2 inches below the level of the ground glass, a single layer of white tissue paper. This does away with the necessity of using any method to shut out the excess light when examining the radiograph.

This simple illuminator has been found to be very convenient and satisfatory.

—Equipment—Portable

See also

France—Army—Sanitary service (Article: "Military Mission to the French Army")

Y. M. C. A.

—War Work

[The Rôle of the Red Triangle. By Albert B. Elliott. *National Service.* Oct, '17. 4600 words. Illustrated.]

This war has been a great tester and prover. Nothing has long endured save those men and those instruments that have been equal to every emergency. The very fact, therefore, that anything has persisted until the present is evidence that it has not been found wanting. Judged on this basis, the Red Triangle work of the Y. M. C. A., which has come to be regarded almost as a new arm of the service, has been an unqualified success. From small beginnings it has grown to tremendous proportions and to corresponding importance.

(The writer goes on to describe the work of the Y. M. C. A. in its special sphere. "It consists in a broad way of supplying the men with creature comforts, furnishing them with wholesome recreational and amusement facilities, setting up for them whenever possible buildings that combine something of home, something of the club, a place where they may read, write home, study, do just as they like for a time. The aim is to do what can be done to rationalize this new and unaccustomed existence.")

[A Winter's Evening at a Y. M. C. A. Canteen. By M. Adeline Boulter-Cook. *United Service Mag.*, Mar, '18. 2200 words.]

(Describing a typical winter evening at a Y. M. C. A. canteen in England, near a camp. The comforts provided—cocoa, sales articles, reading room, etc.—are touched upon, and in some measure the management also. The camp is that of a school for specially selected non-commissioned officers. As a general rule the men are almost pathetically grateful for the service rendered them at the canteen.)

YUNGAY, Battle of

[Notes on the Battle of Yungay. Capt. Felipe de la Barra. *Boletín del Ministerio de Guerra y Marina Peru,* Feb, '18. 3000 words. Map.]

(A very complete discussion of the battle between the Confederate Peruvian Army and the Army of Restoration. The article opens with a general discussion of the situation and the decisions which brought on the battle; a complete list of forces engaged by divisions, giving commanders and chiefs of staff, is added to this. The author then discusses in detail the situation on Jan 19, 1839, and the decision on the part of General Bulores of the Restoration forces, which brought on the battle on the morning of Jan 20. The situation at various times during the day is then taken up. A tactical critique follows, and the article concludes with a discussion of the political situation resulting from the battle of Yungay.)

ZEEBRUGGE

—Operations Against (1918)

[What Happened at Zeebrugge. *Canadian Military Gazette,* May 28, '18. 340 words. Quoted in part.]

"Most interesting is the Berlin communique which describes the forcing of Zeebrugge harbor. Very little was said in the British report of the passive obstacles which barred the way into this port, but they appear to have been quite formidable. Extending from the end of the Mole to the shore was a barrier of boats and chains. According to the Berlin story this boom was easily broken by the block ships, after the outermost pontoons had been "sunk by torpedoes." Boom defenses are notoriously unreliable, but the Germans, with their reputation for thoroness, might have been expected to construct a barrier stout enough to keep out such feeble vessels as the old cruisers employed as block ships. The report proceeds to say that, according to the experience of naval and coastal warfare, blocking attacks which are undertaken under cover of night and fog without regard to loss have always a chance in the case of an open coast to get close up to or into the entrance. As a matter of fact, history teaches the exact contrary. The Americans failed to bottle up Cervera's squadron at Santiago, tho the attempt was made with great skill and determination. At Port Arthur the Japanese made three big attempts to block the channel, sinking no less than 21 large merchant steamers, but entirely without success. Every precedent was against the British expedition, and that it should nevertheless have succeeded so completely at Zeebrugge is, of course, as gall and wormwood to the Huns."

"ZEPPELINS"

See

Dirigibles—Germany